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Characteristics and Evolutionary Laws of The Factor Structure of China's Entire Industry

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Abstract:

Based on clarifying the boundaries of production factors such as labor, land, technology, and capital, this study constructs an industrial factor structure measurement model using an extended C-D production function and input-output analysis. Using panel data of regional total output and factor inputs from 31 Chinese provinces during 2003-2020, along with input-output tables from 2005-2020, the study measures China's overall industrial factor structure at average social production levels from 2005 to 2020.

Analysis of China's industrial factor structure from 2005 to 2020 reveals strengthened labor dominance, weakened technological contribution, land contribution shifting from negative to positive, and overall stable capital contribution. The findings indicate that the substitution and complementary effects among factors are multi-dimensional, dynamic, and non-linear. These interactions drive the dynamic rebalancing of factor structure, while technological innovation emerges as the driving force for China's high-quality sustainable economic development.

Based on these research conclusions, the study proposes policy implications including: strengthening support policies for technological innovation, developing innovative factor allocation and industrial upgrading policies, and introducing policies for innovative international technological cooperation and competition. These suggestions aim to provide reference for formulating China's high-quality sustainable economic development strategy.

The analysis demonstrates that the substitution and complementary relationships between factors are characterized by multi-dimensional, dynamic, and non-linear properties, driving the dynamic rebalancing of factor structure. Furthermore, technological innovation has become the source of power for achieving China's high-quality sustainable economic development.

keyword: The substitution and complementarity between the elements of industrial factor structure, and the dynamic rebalancing of scientific and technological innovation

I. **Introduction**

As the basic unit of total social wealth, industries and their factor structure directly determine resource allocation efficiency, significantly impacting both the qualitative improvement and quantitative growth of the economy. Against the backdrop of China's increasing emphasis on driving effective resource allocation through technological innovation to promote traditional industrial upgrading and development of emerging industries like bio-manufacturing, commercial aviation, and low-altitude economy, as well as future industries such as quantum technology and life sciences to create new economic growth engines, it is necessary to examine the characteristics and evolution patterns of China's industrial factor structure across all sectors. This not only helps identify the contribution and allocation efficiency of various factors constituting industries in different periods but also helps understand the internal driving forces of China's high-quality sustainable development, thereby providing reference for formulating China's high-quality sustainable development strategy.

Current academic research on industrial factor structure mainly focuses on three aspects. First, exploring the effective allocation of factors such as labor and capital across different industries. For example, Xin et al. (2020) constructed a two-part DGE model to study China's cross-industry factor misallocation coefficients from 1993 to 2018, finding that compared to barrier-free scenarios, cross-industry factor misallocation reduced manufacturing labor share by 44% during industrialization and service sector labor share by 5.05% during deindustrialization[1]. Ren Tao et al. (2022) used factor-augmented CES production function to analyze the impact of technological progress and factor allocation bias on total factor productivity across China's three industries from 1993 to 2017[2]. Wu Han et al. (2023) constructed a multi-sector general equilibrium model with endogenous international trade structure to explore the relationship between factor mobility costs and industrial structure transformation and labor productivity growth[3].

Second, analyzing the roles and impacts of different factors in industrial growth and transformation. Jiao Yinxue et al. (2020) found that income disparities mainly stem from secondary and tertiary industries by decomposing labor income across China's three industries[4]. Xiao Jianhua (2022) argued that forcing technological upgrading and reducing technological uncertainty are the dominant forces for emerging industrial development[5]. Chen Linsheng et al. (2024) demonstrated the internal logic of mutual promotion between metaverse technology and complex digital economy industrial development[6]. Clement Moyo et al. (2024) used ARDL boundary testing to show that primary and tertiary industry development in the Eastern Cape is driven by ICT investment[7].

Third, studying how technological changes promote factor enhancement and industrial structure optimization. Xiaoxiao Zhou et al. (2020) proposed that various directed technological progress at the national level can promote industrial structure rationalization[8]. Chen Chuanglian et al. (2021) found that capital-biased technological progress helps industrial structure transformation and upgrading[9]. Zhang Hao et al. (2021) revealed that information technology has significant investment optimization effects on regional industrial structure adjustment[10]. Luo Jia et al. (2023) argued that larger digital technology innovation scale is more conducive to manufacturing enterprises' total factor productivity improvement[11]. Xiaoyan Ren et al. (2023) verified the promoting effect of technological innovation on industrial structure optimization in digital economy[12]. Kedong Yin et al. (2024) found that technological innovation plays a partially positive mediating role in environmental regulation's impact on industrial structure upgrading[13]. Xuehong Zhu et al. (2024) explored digital technology driving industrial structure from a heterogeneity perspective[14].

Existing research focuses on discussing partial factors' allocation in industries or their roles in industrial structure to propose paths for improving factor productivity and optimizing industrial structure, lacking systematic discussion of dynamic evolution of industrial factor structure from an all-industry perspective and insufficient attention to interaction mechanisms and long-term evolution patterns between factors. Therefore, this study examines China's industrial factor structure evolution patterns from an all-industry perspective to enrich existing research while providing valuable insights for China's high-quality sustainable development strategy.

The main innovations of this study are: First, compared to DEA, SFA and other methods that struggle to quantify specific contributions of each factor in industrial output, our industrial factor structure measurement model based on extended C-D production function and input-output analysis can not only measure multi-industry factor structure and reveal quantitative relationships between factors (intermediate industries) constituting industries, but also directly quantify factors' specific contributions to industrial output. Second, compared to existing studies mostly focusing on partial factors' allocation in industries or their roles in industrial structure, this study analyzes characteristics of China's industrial factor structure changes from 2005-2020 from an all-industry perspective, proposing three major patterns: substitution and complementary effects between factors are multi-dimensional, dynamic and non-linear; substitution and complementation between factors drive dynamic rebalancing of factor structure; and technological innovation becomes the source power for achieving China's high-quality sustainable development.

II. Empirical Research Design

2.1 The Constituent Elements of Wealth Creation

Along with the development of economic theory, the composition of production factors has evolved from the Physiocrats' "single-factor theory" of land, through William Petty's "two-factor theory" of labor and land[15], Jean-Baptiste Say's "three-factor theory" of labor, land, and capital[16], Alfred Marshall's "four-factor theory" of labor, land, capital, and entrepreneurial ability[17], to the "five-factor theory" after Romer and Lucas introduced technological factors into new economic growth theory[18][19], and Xu Shoubo's (2012) "six-factor theory" of laborers, labor tools, labor objects, labor space, labor time and labor environment[20], Luo Fukai et al.'s (2001) "six-factor theory" of machinery and raw materials, human resources, financial resources, technology, information and knowledge[21], Zhang Pengxia et al.'s (2012) "five-factor theory" of laborers, labor objects, labor tools, institutions and knowledge[22], Zhou Li'an's (2018) "five-factor theory" of labor, land, capital, technology, data[23], and the "multi-factor theory" proposed by the Fourth Plenary Session of the 19th CPC Central Committee on "improving production factors such as labor, capital, land, knowledge, technology, management, and data", etc. Different from the changes in the composition of production factors arranged according to the development of economic theory, this study examines the dynamic evolution of the constituent elements of wealth creation within the historical process of wealth creation, based on the holistic view of historical materialism and the dynamic and developmental nature of historical processes.

The satisfaction of human survival and development needs depends on the progress of productive forces and improvement of production efficiency, which are determined by effective utilization of factors and changes in production modes. In the early stages of wealth creation, when land was abundant and population was relatively limited, labor was the only source of wealth creation. Later, as population grew rapidly, dependence on land gradually deepened. As population growth rate far exceeded wealth growth rate, land supply-demand conflicts intensified until land was developed to the extreme and became scarce, making it an important factor in wealth creation. The unprecedented population expansion and diversity of human needs made wealth increase increasingly dependent on the improvement of labor skills and breakthrough applications of science and technology, making technology another important factor in wealth creation after labor and land. With deepening professional division of labor, fine division and close cooperation of labor, diverse product varieties, and increasingly complex optimization and integration of labor, land, and technology, capital's position and role as a scientific and effective integrator of various production factors became increasingly prominent, making it an important factor in wealth creation through its scientific and effective organizational function.

Labor creates wealth. With social-economic development and human progress, wealth obtained directly from labor acting on land could no longer meet human survival and development needs. Humans sought change, improved labor skills, practiced intensive cultivation, developed handicraft industry as an important supplement to agricultural economy, leading to the first alienation of labor - from directly acting on labor objects to using simple tools, marking the emergence of science and technology. Science and technology is the primary productive force. With the widespread application of production tools and mechanical equipment (such as steam-powered machines), humans were liberated from heavy physical labor, leading to the second alienation of labor, with human labor trending toward scientific and technological invention, production process upgrades, and optimization management.

The popularization of modern information technology has further catalyzed digital technologies such as Internet of Things (IoT), Artificial Intelligence (AI), big data, cloud computing, advanced robotics, 3D printing, blockchain, etc., accelerating the development of emerging frontier industries like hydrogen energy, new materials, innovative pharmaceuticals, bio-manufacturing, commercial space, low-altitude economy, and future development tracks such as quantum technology and life sciences, as well as "AI+" initiatives. However, the complexity of science and technology, factor optimization combinations, product series and production systems, and production service systems form a complex network of the entire socio-economic system. Only revolutionary breakthrough technology applications in frontier tech industries, environmental optimization and resource recycling in green sustainable economy, and efficient utilization and precise combination of factors in digital economy are the main sources of wealth growth, making science and technology the primary productive force.

Thus, the constituent elements of wealth creation evolved from labor to labor and land, then to labor, land, and technology, and further to labor, land, technology, and capital. Labor is the transformation activity of nature to meet human survival and development needs, usually divided into physical and mental labor. Science and technology is essentially the discovery or invention of connections between things in production practice and the application of these achievements to production practice, being the crystallization of advanced complex labor with amplification effects, mainly presented in the form of machinery and equipment combinations. Capital is wealth used to create wealth;

its source and use indicate that capital originates from wealth accumulation and can organize production factors, create wealth, and concentrate and control resources. Land refers to resources and conditions provided by nature, as well as various products and materials formed after processing and improving these resources and conditions.

2.2 Construction of Industrial Factor Structure Model

As the basic constituent unit of social wealth, industry formation and development rely on the synergistic effects of labor, land, technology and capital. The core of factor synergy lies in the substitution and complementarity between factors, which drives the dynamic adjustment of quantity ratios between industry constituent factors. The quantity ratios between industry constituent factors reflect the relative proportions of different factors in industries, revealing industries' dependence on and usage of different factors, directly affecting their contribution to total wealth (typically measured by GDP).

GDP is the joint result of contributions from labor, land, technology and capital. Based on these factors' contributions to GDP, we can further derive their contributions to different industrial outputs. This is due to: First, the bottom-up cumulative effect. Efficient utilization and optimization of labor, land, technology and capital embedded in industries can improve industrial production efficiency and value-added, thus accumulating contributions to GDP. Second, technological progress and innovation change the quantitative ratio relationships between industry constituent factors, leading to dynamic adjustments in industrial structure. Changes in the quantities of industry constituent factors directly alter various factors' contribution rates to GDP.

Therefore, factors' contribution rates to GDP and the quantity ratios between industry constituent factors jointly form the relative contribution proportions of factors to unit industrial output. From a total factor perspective, industrial factor structure can be defined as the relative contribution proportion relationships of labor, land, technology and capital embedded in industries to unit industrial output.

Theoretically, the relative contribution proportion relationships of labor, land, technology and capital to unit industrial output can be intuitively presented through digital technology. However, in practice, due to multiple factors including statistical caliber, privacy and confidentiality policies, legal and regulatory restrictions, and digital technology levels, it is impossible to obtain data on factors' relative contribution proportions to unit industrial output. Therefore, this paper introduces C-D production function and input-output analysis methods to construct an industrial factor structure measurement model.

On one hand, wealth is the joint result of contributions from labor, land, technology and capital. Following Guo Han et al. (2014)[20], this paper constructs an extended Cobb-Douglas production function to estimate the contribution rates of various production factors in GDP. The relationship between total output and various production factors can be expressed by equation 1:

$$Y = AL^{\alpha_L}T^{\alpha_T}R^{\alpha_R}K^{\alpha_K} \quad (1)$$

In Equation 1, $\alpha_L, \alpha_T, \alpha_R, \alpha_K$ they respectively represent the output elasticity of labor, land, technology, and capital, reflecting the current contribution rates of labor, land, technology, and capital; A is a constant term indicating the technological level; L, T, R, K they respectively represent the input of labor, land, technology, and capital.

On the other hand, according to input-output analysis methods, industries are composed of various intermediate industries and initial factors, represented by the relationship between columns composed of the first and third quadrants of the input-output table. The quantitative proportion relationships between industry components are jointly formed by the quantitative proportion relationships between industries in the intermediate industry section and the quantitative proportion relationships between elements in the initial factors section. Since initial factors are only directly and partially transformed into final industries, the quantitative proportion relationships between elements in the initial factors section are determined by the direct consumption coefficients of this section. Meanwhile, the effective linkage support of initial factors transforms all types of intermediate industries into another part of final industries. The quantitative proportion relationships between industries in the intermediate industry section are represented by the complete consumption coefficients of this section, which are further transformed into quantitative proportion relationships between factors using the direct consumption coefficients of the initial factors section. The relationships between initial factors, intermediate industries, and final industries are shown in Figure 1.

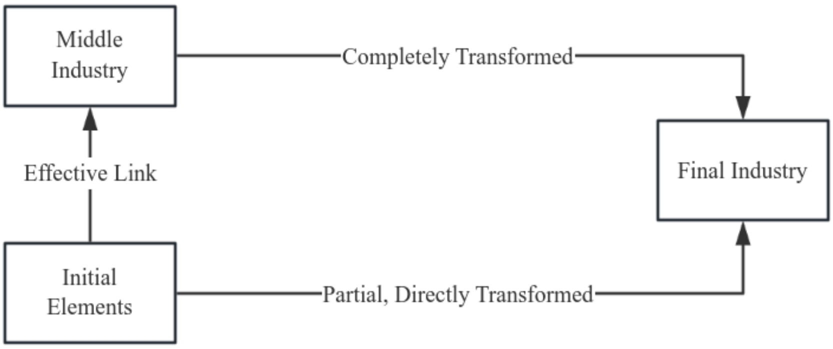

Figure 1: Intrinsic Connections Between Initial Elements, Intermediate Industries, and Final Industries

Combined with Figure 1, the direct consumption coefficients of initial factors can be expressed as:

$$a_{zj} = X_{zj}/X_j \qquad (2)$$

In the above equation, z represents the types of factors; a_{zj} represents the amount of initial factor z directly consumed when producing one unit of output in final industry j; X_{zj} and X_j represent the initial factor z input for producing final industry j and the total output of final industry j, respectively.

The complete consumption coefficient of intermediate industrial sectors is represented by the following recursive equation:

$$c_{ij} = b_{ij} + \sum_{h=1}^{n} b_{ih} c_{hj} \qquad (3)$$

In equation (3), b_{ij} is the direct consumption coefficient of intermediate industrial sectors, representing the input amount of other intermediate industries directly consumed per unit of output in final industry j;$\sum_{h=1}^{n} b_{ih} c_{hj}$ it indicates the indirect input provided by intermediate industry i to final industry j; c_{ij} is the complete consumption coefficient of intermediate industrial sectors, representing the total input amount of other intermediate industries consumed per unit of output in final industry j.

Combining equations (2) and (3), the quantity ratio between intermediate industries is further transformed into the quantity ratio between factors, namely:

$$d_{zj} = a_{zj} c_{ij} \qquad (4)$$

In equation (4), d_{zj} represents the complete input amount of factor z consumed per unit of output in final industry j through intermediate industrial sectors. Combining equations (2) and (4), the quantity ratio relationship between industry-composing factors is formed as:

$$f_{zj} = a_{zj} + d_{zj} \qquad (5)$$

In the above equation, f_{zj} represents the final input amount of factor z required per unit of output in final industry j. Thus, combining the factor output elasticity and the quantity ratio between industry-composing factors, the industrial factor structure can be obtained as:

$$g_{zj} = \alpha_z f_{zj} \qquad (6)$$

Where,g_{zj} represents the relative contribution of factor z embedded in final industry j to the unit output of that industry (abbreviated as "relative contribution of factor z");α_z represents the output elasticity of factor z.

2.3 Data Sources and Processing

Based on the established econometric model of industrial factor structure, this paper further calculates the factor structure of all industries. Due to data availability limitations, this study follows China's input-output tables from 2005 to 2020, calculating the factor structure of all industries at the average social production level for the years 2005, 2007, 2010, 2012, 2015, 2017, 2018, and 2020 (hereinafter referred to as "2005-2020"). Data sources include the "China Statistical Yearbook," "China Urban and Rural Construction Statistical Yearbook," "China Science and Technology Statistical Yearbook," and various provincial statistical yearbooks.

First, due to differences in the number and categories of industries presented in China's input-output tables from 2005 to 2020, based on practical statistical needs and processing convenience, this paper adjusts and categorizes all industries from the 2005-2020 input-output tables into 38 categories as listed in Appendix 1, ensuring consistency and comparability of industrial data.

Regarding the selection of indicators, data processing, and panel models for estimating factor contribution rates, please refer to Yan Feng et al. (2024)[21]. For calculating the quantitative proportions between industrial component factors, after adjusting and categorizing all industries into 38 categories based on the input-output tables, the intermediate industry portion directly uses the first quadrant of the original input-output tables. For initial factors, labor factor input, technological factor input, and capital factor input use labor compensation, fixed asset depreciation, and total fixed capital formation from the original input-output tables, respectively, while land factor input is represented by the difference between total value added and the sum of labor compensation, fixed asset depreciation, and total fixed capital formation.

III. Analysis of Empirical Results

Based on equation (1), using Stata 14 software to estimate the factor contribution rates of 31 provinces in China from 2003 to 2020. Since this paper only involves China's input-output tables for 2005, 2007, 2010, 2012, 2015, 2017, 2018, and 2020, the trends of factor contribution rates (after normalization) for the relevant years are shown in Figure 2. It should be noted that to prevent spurious regression, LLC test was selected for stationarity testing. The test results show that all selected variables become stationary after first-order differencing. Subsequently, multicollinearity testing was conducted, with all VIF values less than 5; the residual terms did not vary with sample values, indicating no heteroscedasticity; robustness tests were passed by changing standard errors and using system GMM.

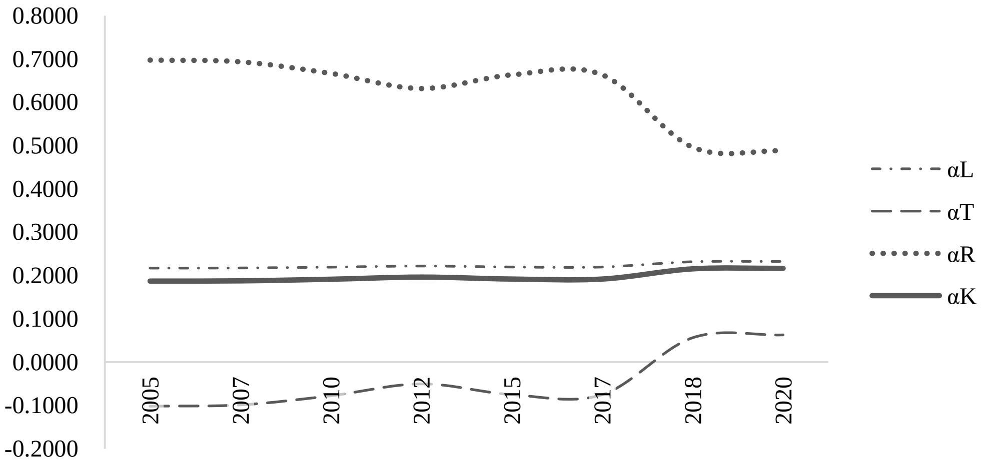

Figure 2 Factor Contribution Rates in China from 2005 to 2020

Combining factor contribution rate data and industrial factor structure econometric model, using Excel to process relevant data, the factor structure of all industries in China from 2005 to 2020 is calculated as shown in Table 1.

Table 1 The factor structure of the whole industry in China from 2005 to 2020

Industry code	g_{zj}	2005	2007	2010	2012	2015	2017	2018	2020
1	g_{L1}	0.7235	0.7535	0.7343	0.7706	0.7927	0.7616	0.7911	0.8229
	g_{T1}	-0.0457	-0.0403	-0.0140	-0.0054	-0.0094	-0.0090	0.0107	0.0108
	g_{R1}	0.2493	0.2380	0.2017	0.1758	0.1639	0.1959	0.1520	0.1273
	g_{K1}	0.0729	0.0488	0.0780	0.0590	0.0528	0.0515	0.0461	0.0390
2	g_{L2}	0.4639	0.5405	0.5916	0.6097	0.5405	0.6368	0.5123	0.4962
	g_{T2}	-0.2447	-0.2157	-0.1858	-0.1035	-0.1040	-0.1954	0.1113	0.1275
	g_{R2}	0.6357	0.5594	0.4677	0.4004	0.4549	0.4745	0.3062	0.3121
	g_{K2}	0.1451	0.1158	0.1265	0.0934	0.1086	0.0841	0.0703	0.0643
3	g_{L3}	0.4088	0.5297	0.4310	0.4679	0.3493	0.2835	0.2475	0.2548
	g_{T3}	-0.7628	-0.4712	-0.2422	-0.2003	-0.1287	-0.1477	0.1102	0.1085
	g_{R3}	1.2002	0.7973	0.6861	0.6239	0.7108	0.8171	0.6007	0.5922
	g_{K3}	0.1538	0.1443	0.1252	0.1086	0.0686	0.0470	0.0416	0.0445
...	...	...	...	...	...	...	...	...	...
36	g_{L36}	0.5938	0.6406	0.6810	0.6903	0.6954	0.5569	0.5882	0.5876
	g_{T36}	-0.0714	-0.1054	-0.0258	-0.0199	-0.0218	-0.0337	0.0246	0.0240
	g_{R36}	0.3789	0.4003	0.3103	0.2973	0.3034	0.4464	0.3534	0.3566
	g_{K36}	0.0987	0.0644	0.0344	0.0322	0.0231	0.0305	0.0338	0.0317
37	g_{L37}	0.4861	0.5465	0.5555	0.5506	0.5908	0.5168	0.5123	0.5163
	g_{T37}	-0.2099	-0.2262	-0.1060	-0.0716	-0.0890	-0.0617	0.0325	0.0323
	g_{R37}	0.6169	0.5928	0.4819	0.4579	0.4442	0.5016	0.3745	0.3807
	g_{K37}	0.1068	0.0869	0.0686	0.0631	0.0540	0.0432	0.0808	0.0707
38	g_{L38}	0.5288	0.5862	0.6111	0.6347	0.6644	0.5801	0.6012	0.5994
	g_{T38}	-0.0909	-0.1001	-0.0481	-0.0303	-0.0377	-0.0371	0.0256	0.0269
	g_{R38}	0.4610	0.4315	0.3675	0.3306	0.3178	0.4019	0.3142	0.3139
	g_{K38}	0.1011	0.0824	0.0696	0.0650	0.0555	0.0550	0.0590	0.0597

According to Table 1, Figure 3 further shows the average relative contributions of various factors across all industries in China from 2005 to 2020. It should be noted that while the factor contribution rates in Figure 2 provide a preliminary quantification of the marginal contributions of various factors to the overall national economy, it is necessary to consider the input structure and scale of different industries for a more accurate measurement of the factors' roles across industries. Therefore, the average relative contribution of factors across all industries is a more comprehensive, thorough, and representative macro-analysis indicator that can more precisely reveal the characteristics and evolution of factor structures across industries. Moreover, both theoretically and practically, the trends in the average relative contribution of factors across all industries shown in Figure 3 should generally be consistent with the trends in factor contribution rates shown in Figure 2.

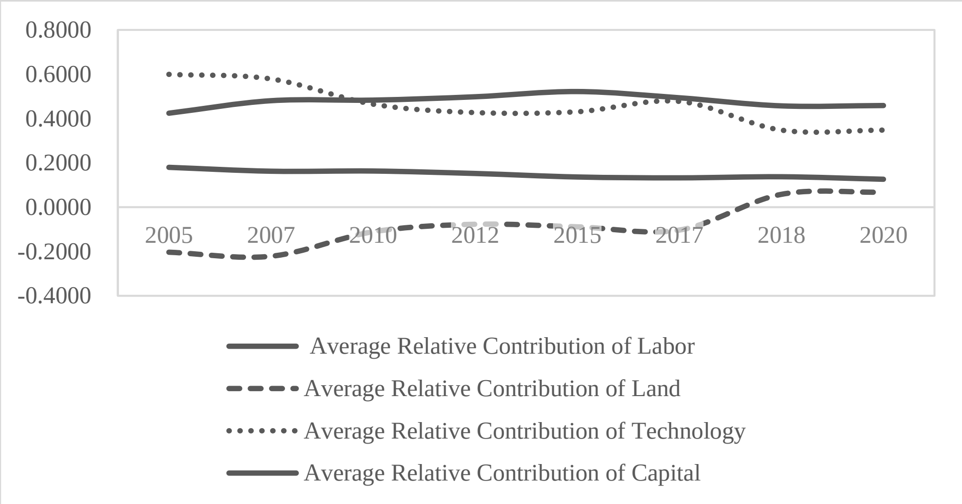

Figure 3 Change trend of the average relative contribution of all elements of the whole industry in China from 2005 to 2020

From Figure 3, it can be seen that China's average relative contribution of various factors across all industries changed significantly from 2005 to 2020. The average relative contribution of labor showed a trend of rising and then slightly declining, increasing from 0.4241 in 2005 to 0.5219 in 2015, and gradually falling to 0.4587 in 2020. Although the average relative contribution of labor declined after peaking in 2015, it maintained a relatively high level overall, and labor's contribution remained the largest in all industries, indicating that labor's dominance strengthened to some extent.The possible reasons for the strengthened dominance of labor factors include three aspects:First, the demographic dividend deeply integrated with the urbanization process. China was in its demographic dividend period from 2005 to 2020, with abundant labor supply, mainly consisting of young, working-age population. Meanwhile, accelerated urbanization further released labor production and demand potential, with large-scale rural labor force migration to cities, shifting from traditional agriculture to manufacturing and service industries, which both improved marginal labor output and stimulated labor demand.Second, labor quality improved significantly. With China's economic transformation and upgrading, national investment in education and vocational training increased year by year, leading to significant improvement in labor quality. High-quality workers not only have the ability to adapt to new technologies and complex processes but can also complete production tasks more efficiently. More importantly, high-quality workers can develop new technologies, products, and markets through their enhanced knowledge, experience, and creative thinking. For example, tech giants like Huawei and Tencent have promoted the training and employment of numerous highly skilled engineers and data scientists. These companies continuously improve employees' professional skills through internal learning platforms, regular technical seminars, and cooperation with domestic and international universities, enabling them to handle complex algorithms and large datasets.Third, the substitution and complementarity between technology and labor. On one hand, the widespread application of automation and information technology has replaced low-skilled labor to some extent, promoting labor productivity improvement and optimizing labor factor allocation. On the other hand, technological progress has created many emerging industries and positions that require high-quality workers, and the complementary effect between technology and labor enables workers to more effectively invent, operate, and manage new technologies.

The relative technical contribution has shown a continuous declining trend, gradually decreasing from 0.5995 in 2005 to 0.3477 in 2020, indicating a weakening trend. The weakening of technological contribution may stem from the following aspects:First, diminishing technological effects. When new technologies are initially introduced, they can significantly improve efficiency and reduce costs.

However, as the scale economies of product quantity expansion and scope economies of product-related expansion are realized and saturated, the initial significant benefits gradually weaken.Second, limited technology amplification effects. Between 2005 and 2020, many Chinese industries, especially traditional sectors, have already experienced initial technology amplification effects. Further technological breakthroughs have become more challenging, with slower diffusion rates, indicating limitations in widespread application and cross-industry integration.Third, technological advancement and innovation bottlenecks. In high-tech fields, technological innovation faces bottlenecks, with research difficulties and high R&D costs limiting their speed and breadth, resulting in limited breakthrough progress in some key core technologies and disruptive original technologies. This is particularly evident in capital-intensive and high-technology threshold industries.Fourth, mismatch between industrial structure and technology. With China's rapid economic development, the matching degree between industrial structure and technological progress has not fully achieved coordination. In traditional labor-intensive industries, the marginal contribution of technology has gradually declined, while the potential contribution of emerging high-tech industries has not been fully released.Fifth, technology diffusion lag. There is a time lag between technology invention and widespread application, leading to potentially weakened contributions in the short term. Especially during periods of rapid economic transformation and structural adjustment, the speed of new technology promotion often lags behind industrial demand. For instance, emerging technologies like artificial intelligence and blockchain were still in their early stages of practical application between 2005 and 2020.Sixth, dependence on external technological resources. While China has demonstrated strong technological advancement in areas such as 5G technology, solar photovoltaics, and new energy vehicles, some core technologies (such as semiconductor chips and high-end equipment manufacturing) still rely on imports and external technology. This limits China's autonomy in global supply chains, particularly when facing external technology blockades or supply chain disruptions. Although the introduction of external technology can improve productivity in the short term, excessive dependence on external technology supply is unfavorable for enhancing local technological innovation capabilities in the long run, leading to weakened technological factor contributions.

The average relative contribution of land was negative in 2005 and 2007, gradually improved from 2010, and turned positive in 2018 and 2020, indicating a progressive improvement in land use efficiency. The possible main causes of land contribution fluctuations and transitions are:First, the substitution and complementary effects between technology and land. In the early period, especially around 2005, China's rapid economic growth mainly relied on large-scale land input. However, due to low technological levels and inefficient land utilization, the average relative contribution of land was negative. After 2010, with increased investment in technological innovation and improved innovation levels, the application and popularization of agricultural mechanization, industrial mechanization, and intelligent manufacturing technologies significantly enhanced land productivity, gradually reversing the negative average relative contribution of land. By 2018 and 2019, the synergistic effect of technology and land turned the average relative contribution of land positive, increasing land's contribution to total industrial output.Second, China's land system reform. Since 2000, China has legislated to standardize the contracted land system, reformed the construction land system, and promulgated a series of normative documents such as "Notice on Properly Handling the Transfer of Rural Household Contracted Land Use Rights," "Rural Land Contract Law," "Management Measures for Rural Land Contract Management Right Certificates," and "Management Measures for Rural Land Contract Management Right Transfer." These reforms improved land mobility and utilization efficiency, encouraged large-scale land operation and efficient use, thereby improving land's economic contribution. Meanwhile, through optimizing allocation and intensive use of urban land via the land auction system, and increasing land transfer fees to enhance local government investment in infrastructure and public services, land use efficiency and economic benefits were indirectly improved.

The average relative contribution of capital has remained generally stable with a small range of fluctuation. This characteristic largely stems from the substitution and complementarity between technology and capital, as well as the control of capital investment flow under the emerging whole-nation system. Regarding the substitution and complementarity between technology and capital, after 2005, China's economic structure gradually shifted from labor-intensive to technology-intensive. In the early stages, large amounts of capital were invested in infrastructure and traditional manufacturing, driving economic growth. However, as China gradually transitioned from "investment-driven" to "innovation-driven" growth, capital's substitution effect for technology weakened, instead relying on technological advancement to improve production efficiency. Entering 2010, China increasingly emphasized the power of scientific and technological innovation, with increased investment in innovation and technology, such as China's "Made in China 2025" strategy. Capital and technology formed a close complementary relationship, with capital not only used for production scale expansion but more importantly supporting technological R&D and innovative applications. The weakening of the substitution effect and strengthening of the complementary effect stabilized capital's economic contribution.Regarding capital investment flow control under the emerging whole-nation system, after 2005, especially following the global financial crisis, the Chinese government strengthened macroeconomic regulation through strategic guidance of capital flows, enhanced financial market supervision, and reformed and stabilized state-owned enterprises to ensure the effectiveness and stability of capital input. For example, the government guided capital flows toward strategic emerging industries such as new energy, semiconductors, and biotechnology through special funds and tax incentives; implemented strict financial supervision policies through capital adequacy requirements and shadow banking control to effectively prevent systemic financial risks and reduce capital fluctuations; deepened state-owned enterprise reform, gradually transforming from "big but not strong" to "strong and orderly" through optimizing capital structure and improving operational efficiency.

IV. Research Conclusions and Policy Implications

Based on defining the constituent elements of wealth creation, this paper constructs an industry factor structure measurement model using an extended C-D production function and input-output analysis, and further calculates China's industry factor structure from 2005 to 2020, analyzing its changing characteristics and evolution patterns. The main conclusions of this paper are as follows:

(1) According to the trends in the average relative contribution of factors across all industries in China from 2005 to 2020, labor contribution dominance has strengthened, technological contribution has weakened, land contribution has shifted from negative to positive, and capital contribution has remained relatively stable. Specifically, the changes in the average relative contributions of labor, land, and capital all stem from substitution and complementary effects with technology. The average relative contribution of technology has shown a weakening trend due to factors such as continuous diminishing technological effects, limited technology amplification effects, technological innovation bottlenecks, mismatches between industrial structure and technology, lag in technology diffusion, and dependence on external technological resources.

(2) The substitution and complementary effects among factors are multi-dimensional, dynamic, and non-linear. The possible causes of changes in the average relative contribution of each factor indicate that factor contributions are not independent, but rather influence the overall industrial factor structure through substitution and complementary effects among factors. These substitution and complementary relationships are not fixed but adjust dynamically with changes in economic development, industrial structure adjustment, and technological progress (such as the weakening substitution effect and strengthening complementary effect between technology and capital), and exhibit non-linearity derived from the relative force of factors at different development stages.

(3) The substitution and complementary effects among factors drive the dynamic rebalancing of factor structure. These effects not only enhance the efficiency of factor utilization embedded in industries but also promote dynamic adjustment and rebalancing of the internal factor structure within industries. This rebalancing process typically manifests as readjustments in resource allocation, functional distribution, and operational mechanisms of various factors to adapt to changes in internal and external environments. Dynamic rebalancing is an adaptive process that is not merely reactive but actively adjusting. Factors such as labor, land, capital, and technology form a systemic effect through substitution and complementation. When labor factor dominance strengthens, technological progress improves labor productivity and optimizes factor allocation efficiency. Land contribution indicates improved land use efficiency, triggering reallocation of other factors. Stable capital contribution provides security for factor substitution and complementation, enabling effective diffusion of technological progress among factors. The weakening of technological contribution emphasizes the need to adjust the matching degree between industrial structure and technology to maintain sustained synergistic effects. Through factor substitution and

complementation, industrial factor structure breaks down and reorganizes, achieving new optimized equilibrium, thereby enhancing industrial robustness and adaptability, and achieving high-quality sustainable industrial development.

(4) Scientific and technological innovation has become the driving force for achieving high-quality sustainable economic development in China. According to World Bank statistics, since 2000, global economic growth rates have mostly remained below 3%, with the world economy experiencing long-term low growth, while China's economy has maintained medium to high-speed growth. This phenomenon can be explained by the fact that although China's technological development and application were relatively lagging over the past decade or more, it achieved medium to high-speed economic growth through large-scale industrial structure upgrading and infrastructure construction, relying on its massive domestic market and low-cost advantages. However, this growth largely depended on economic growth driven by the expansion of production factor quantities, with weakened technological contribution. Now, as China narrows its technological gap with Western developed countries and places increasing emphasis on breakthroughs in key core technologies and revolutionary disruption through original technologies, the mode of economic growth is shifting from extensive to intensive, driven by technological innovation optimizing resource allocation. Technological innovation-driven resource optimization has become the driving force for achieving high-quality sustainable economic development, marked primarily by significant improvements in total factor productivity.

This study provides significant implications for promoting high-quality and sustainable economic development:

(1) Strengthen Science and Technology Innovation Support Policies

Focus policies on frontier and disruptive technologies by establishing a “Future Technology Innovation Fund” to support fields with transformative potential, such as quantum computing, low-altitude economy, and artificial intelligence. Implement competitive funding mechanisms and “challenge-based” project selection systems to incentivize enterprises, universities, and research institutes to compete in real-world application scenarios, fostering cross-sector innovation. Launch “Science and Technology Free Zones” pilots in designated areas to trial flexible research management mechanisms, allowing researchers to start businesses and hold equity in their technologies to maximize innovation potential. Encourage enterprises to establish “Internal Innovation Venture Funds” to support high-risk internal projects, transforming enterprises into core engines of innovation, breaking traditional constraints, and accelerating marketization of scientific achievements.

(2) Develop Innovative Factor Allocation and Industrial Upgrade Policies

Build an “Intelligent Factor Allocation Platform” using AI and blockchain to track real-time factor flows and optimize resource allocation. Pilot “Shared Factor Markets” to enable flexible cross-industry and cross-regional mobility of capital, technology, and talent. Promote “Industrial Ecosystem Alliances” to integrate high-tech and traditional industries, encouraging joint R&D between large and small enterprises to enhance supply chain synergy and risk resilience. Establish a “Factor Innovation Guidance Fund” with mixed-ownership capital models to drive technological upgrades in emerging and traditional industries, accelerating smart manufacturing and green economy transitions.

(3) Implement Innovative International Technology Cooperation and Competition Policies

Create a “Global Technology Standards Leadership Fund” to support Chinese entities in shaping international standards for critical technologies. Encourage domestic firms to co-build R&D centers with Belt and Road Initiative countries, leveraging localized resources for global innovation networks. Pilot “Technology Sharing Zones” to enable international firms to share facilities and data, fostering cross-border talent and innovation flows. Adopt a “Technology Diplomacy” strategy through intergovernmental agreements, transnational platforms, and competitions to solidify China’s pivotal role in global supply chains and technological ecosystems.

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Appendix 1 The Entire Industry Code and its Name

Industry code	Industry name	Industry code	Industry name
1	Agriculture, forestry, animal husbandry and fishery products and services	20	Instrumentation and cultural office machinery
2	Coal extraction and selection products	21	Other manufacturing products and scrap products
3	Oil and natural gas extraction products	22	Electric power heat
4	Metal ore mining and dressing products	23	gas
5	Non-metallic ore and other mineral mining products	24	water
6	Food and tobacco	25	building
7	drygoods	26	Transportation, storage, and postal services
8	Textile, clothing, shoes, hats, leather and down and their products	27	Information transmission, computer services, and software
9	Wood-processing goods and furniture	28	Wholesale and Retail
10	Paper-making, printing and cultural, educational and sporting goods	29	Accommodation and catering
11	Petroleum, coking products, and nuclear fuel processing products	30	Finance and Insurance
12	chemical products	31	real estate；realty
13	Non-metallic mineral products	32	Leasing, business services, and tourism
14	Metal smelting and calendering and processing products	33	Scientific research and technical services
15	metalwork	34	Geological exploration, water conservancy, environment and public facilities management
16	General-purpose and special-purpose equipment	35	Resident services, repair, and other services
17	transport and communication facilities	36	education
18	Electrical machinery and equipment	37	Culture, sports, and entertainment
19	Communication equipment, computers, and other electronic equipment	38	Health, social security, social services, public administration, and social organizations

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Appendix 2 China 2005-2020

Industry code	g_{zj}	2005	2007	2010	2012	2015	2017	2018	2020
1	g_{L1}	0.7235	0.7535	0.7343	0.7706	0.7927	0.7616	0.7911	0.8229
	g_{T1}	-0.0457	-0.0403	-0.0140	-0.0054	-0.0094	-0.0090	0.0107	0.0108
	g_{R1}	0.2493	0.2380	0.2017	0.1758	0.1639	0.1959	0.1520	0.1273
	g_{K1}	0.0729	0.0488	0.0780	0.0590	0.0528	0.0515	0.0461	0.0390
2	g_{L2}	0.4639	0.5405	0.5916	0.6097	0.5405	0.6368	0.5123	0.4962
	g_{T2}	-0.2447	-0.2157	-0.1858	-0.1035	-0.1040	-0.1954	0.1113	0.1275
	g_{R2}	0.6357	0.5594	0.4677	0.4004	0.4549	0.4745	0.3062	0.3121
	g_{K2}	0.1451	0.1158	0.1265	0.0934	0.1086	0.0841	0.0703	0.0643
3	g_{L3}	0.4088	0.5297	0.4310	0.4679	0.3493	0.2835	0.2475	0.2548
	g_{T3}	-0.7628	-0.4712	-0.2422	-0.2003	-0.1287	-0.1477	0.1102	0.1085
	g_{R3}	1.2002	0.7973	0.6861	0.6239	0.7108	0.8171	0.6007	0.5922
	g_{K3}	0.1538	0.1443	0.1252	0.1086	0.0686	0.0470	0.0416	0.0445
4	g_{L4}	0.4612	0.4848	0.4987	0.5150	0.4917	0.5305	0.4194	0.4045
	g_{T4}	-0.3675	-0.2570	-0.1896	-0.1027	-0.1369	-0.2137	0.1239	0.1618
	g_{R4}	0.7345	0.6313	0.5302	0.4729	0.5065	0.5827	0.3730	0.3659
	g_{K4}	0.1718	0.1409	0.1607	0.1148	0.1388	0.1005	0.0838	0.0679
5	g_{L5}	0.4506	0.4895	0.4909	0.5215	0.5152	0.5213	0.4729	0.4752
	g_{T5}	-0.2960	-0.2413	-0.1593	-0.0996	-0.1152	-0.1074	0.0717	0.0804
	g_{R5}	0.6677	0.6338	0.5081	0.4480	0.4505	0.4931	0.3682	0.3699
	g_{K5}	0.1777	0.1180	0.1602	0.1301	0.1495	0.0930	0.0872	0.0745
6	g_{L6}	0.6591	0.6666	0.6862	0.6893	0.7424	0.6927	0.6374	0.6537
	g_{T6}	-0.2433	-0.1729	-0.1128	-0.0725	-0.1111	-0.0966	0.0665	0.0764
	g_{R6}	0.4909	0.4466	0.3419	0.3156	0.3067	0.3453	0.2439	0.2259
	g_{K6}	0.0933	0.0597	0.0848	0.0676	0.0621	0.0585	0.0523	0.0441
7	g_{L7}	0.5385	0.6096	0.6119	0.6429	0.6799	0.6179	0.5859	0.5935
	g_{T7}	-0.1877	-0.2185	-0.1120	-0.0708	-0.0952	-0.0789	0.0553	0.0607
	g_{R7}	0.5504	0.5287	0.4165	0.3598	0.3522	0.4020	0.3030	0.2961
	g_{K7}	0.0988	0.0802	0.0836	0.0681	0.0632	0.0589	0.0558	0.0496
8	g_{L8}	0.5832	0.6452	0.6282	0.6437	0.6961	0.6215	0.5756	0.5777

	g_{T8}	-0.2329	-0.2461	-0.1224	-0.0870	-0.1190	-0.0940	0.0630	0.0747
	g_{R8}	0.5467	0.5200	0.4083	0.3691	0.3571	0.4092	0.2999	0.2927
	g_{K8}	0.1030	0.0808	0.0859	0.0742	0.0657	0.0633	0.0615	0.0549
9	g_{L9}	0.4947	0.4883	0.4941	0.5060	0.5589	0.5005	0.4915	0.5130
	g_{T9}	-0.1919	-0.1185	-0.0695	-0.0428	-0.0733	-0.0435	0.0255	0.0418
	g_{R9}	0.5273	0.4068	0.3806	0.3535	0.3578	0.3658	0.2810	0.2833
	g_{K9}	0.1699	0.2235	0.1948	0.1833	0.1567	0.1772	0.2020	0.1619
10	g_{L10}	0.4689	0.5114	0.5119	0.5425	0.5805	0.5453	0.4916	0.4943
	g_{T10}	-0.2547	-0.2607	-0.1356	-0.0876	-0.1229	-0.1203	0.0781	0.0897
	g_{R10}	0.6598	0.6369	0.5035	0.4510	0.4471	0.4888	0.3486	0.3429
	g_{K10}	0.1259	0.1124	0.1202	0.0940	0.0954	0.0862	0.0817	0.0730

Appendix 2 Continuation Table

Industry code	g_{zj}	2005	2007	2010	2012	2015	2017	2018	2020
11	g_{L11}	0.3780	0.4816	0.4577	0.4848	0.4381	0.3767	0.2915	0.3047
	g_{T11}	-0.5278	-0.3665	-0.2754	-0.1938	-0.1954	-0.2389	0.1411	0.1433
	g_{R11}	1.0212	0.7630	0.6927	0.6039	0.6648	0.8016	0.5193	0.5013
	g_{K11}	0.1286	0.1220	0.1251	0.1050	0.0925	0.0606	0.0482	0.0506
12	g_{L12}	0.4270	0.4968	0.5032	0.5270	0.5550	0.5182	0.4441	0.4516
	g_{T12}	-0.2853	-0.2883	-0.1659	-0.1120	-0.1411	-0.1580	0.0993	0.1087
	g_{R12}	0.7378	0.6865	0.5543	0.4970	0.5013	0.5688	0.3929	0.3812
	g_{K12}	0.1205	0.1051	0.1084	0.0880	0.0848	0.0710	0.0638	0.0585
13	g_{L13}	0.4491	0.4936	0.4933	0.4882	0.5091	0.5021	0.4359	0.4263
	g_{T13}	-0.2662	-0.2804	-0.1738	-0.0974	-0.1307	-0.1494	0.0966	0.1138
	g_{R13}	0.6849	0.6698	0.5528	0.5002	0.5021	0.5621	0.3940	0.3926
	g_{K13}	0.1323	0.1170	0.1278	0.1090	0.1196	0.0853	0.0735	0.0674
14	g_{L14}	0.3841	0.4585	0.4454	0.4682	0.4725	0.4865	0.3980	0.3859
	g_{T14}	-0.2901	-0.2998	-0.1537	-0.1168	-0.1286	-0.1926	0.1160	0.1385
	g_{R14}	0.7645	0.6990	0.5727	0.5437	0.5463	0.6275	0.4207	0.4153
	g_{K14}	0.1415	0.1423	0.1355	0.1048	0.1098	0.0786	0.0653	0.0603
15	g_{L15}	0.3674	0.4180	0.4520	0.4292	0.4585	0.4710	0.4331	0.4244

	g_{T15}	-0.1918	-0.2081	-0.1289	-0.0617	-0.0859	-0.1029	0.0685	0.0842
	g_{R15}	0.6116	0.5881	0.5141	0.4300	0.4437	0.4844	0.3574	0.3584
	g_{K15}	0.2129	0.2020	0.1628	0.2025	0.1836	0.1474	0.1410	0.1329
16	g_{L16}	0.2019	0.2494	0.2772	0.2790	0.3092	0.3026	0.3302	0.3330
	g_{T16}	0.0682	0.0309	0.0390	0.0405	0.0416	0.0448	-0.0458	-0.0436
	g_{R16}	0.3077	0.3143	0.2923	0.2536	0.2787	0.2891	0.2527	0.2587
	g_{K16}	0.4221	0.4054	0.3916	0.4268	0.3705	0.3635	0.4629	0.4519
17	g_{L17}	0.2491	0.2597	0.2517	0.2727	0.3083	0.2751	0.3065	0.3376
	g_{T17}	0.0011	0.0297	0.0603	0.0446	0.0382	0.0459	-0.0429	-0.0147
	g_{R17}	0.3921	0.3199	0.2594	0.2411	0.2679	0.2737	0.2424	0.2681
	g_{K17}	0.3577	0.3907	0.4286	0.4416	0.3855	0.4053	0.4939	0.4091
18	g_{L18}	0.3283	0.3404	0.3453	0.3837	0.4258	0.4129	0.4071	0.4034
	g_{T18}	-0.1185	-0.1072	-0.0229	-0.0315	-0.0557	-0.0580	0.0447	0.0561
	g_{R18}	0.5251	0.4552	0.3733	0.3657	0.3986	0.4252	0.3342	0.3361
	g_{K18}	0.2651	0.3116	0.3043	0.2821	0.2313	0.2199	0.2140	0.2044
19	g_{L19}	0.2581	0.3339	0.3679	0.4192	0.4871	0.4024	0.4163	0.4141
	g_{T19}	-0.0052	-0.0926	-0.0190	-0.0284	-0.0625	-0.0149	0.0030	0.0113
	g_{R19}	0.4254	0.4797	0.3797	0.3675	0.3940	0.3878	0.3147	0.3270
	g_{K19}	0.3217	0.2790	0.2714	0.2416	0.1813	0.2248	0.2660	0.2476
20	g_{L20}	0.2360	0.3139	0.3491	0.3743	0.4004	0.4276	0.4124	0.4098
	g_{T20}	0.0351	-0.0393	0.0019	-0.0069	-0.0137	-0.0445	0.0227	0.0348
	g_{R20}	0.3470	0.3861	0.3310	0.3071	0.3225	0.3641	0.2778	0.2831
	g_{K20}	0.3819	0.3393	0.3181	0.3255	0.2909	0.2529	0.2871	0.2722

Appendix 2 Continuation Table

Industry code	g_{zj}	2005	2007	2010	2012	2015	2017	2018	2020
21	g_{L21}	0.5776	0.6650	0.5245	0.7103	0.5490	0.8060	0.4601	0.4534
	g_{T21}	-0.4246	-0.5701	-0.2298	-0.4072	-0.1257	-0.5323	0.2045	0.2202
	g_{R21}	0.5939	0.6169	0.4168	0.5510	0.4657	0.6389	0.2891	0.2876
	g_{K21}	0.2532	0.2882	0.2884	0.1459	0.1110	0.0874	0.0462	0.0387
22	g_{L22}	0.3053	0.2803	0.3547	0.3835	0.4084	0.3498	0.3391	0.3256

	g_{T22}	-0.1925	-0.1453	-0.1046	-0.0799	-0.1243	-0.0928	0.0633	0.0718
	g_{R22}	0.7590	0.7836	0.6533	0.6111	0.6204	0.6807	0.5325	0.5407
	g_{K22}	0.1281	0.0814	0.0966	0.0853	0.0955	0.0623	0.0651	0.0619
23	g_{L23}	0.3640	0.3991	0.4815	0.4447	0.4616	0.3655	0.3261	0.3284
	g_{T23}	-0.2213	-0.2300	-0.1797	-0.1513	-0.1495	-0.1321	0.0945	0.0995
	g_{R23}	0.7487	0.7368	0.5834	0.6238	0.6084	0.7241	0.5386	0.5301
	g_{K23}	0.1085	0.0941	0.1148	0.0828	0.0795	0.0424	0.0408	0.0420
24	g_{L24}	0.3147	0.3240	0.3409	0.3910	0.4481	0.4167	0.4009	0.3821
	g_{T24}	-0.1354	-0.1038	-0.0650	-0.0460	-0.0902	-0.0887	0.0597	0.0654
	g_{R24}	0.7355	0.7258	0.6684	0.6039	0.5740	0.6312	0.4986	0.5156
	g_{K24}	0.0852	0.0540	0.0557	0.0511	0.0681	0.0408	0.0408	0.0369
25	g_{L25}	0.1919	0.1915	0.2226	0.2474	0.2534	0.2351	0.3005	0.3053
	g_{T25}	0.1407	0.1301	0.1135	0.0765	0.1103	0.1165	-0.1071	-0.1201
	g_{R25}	0.2033	0.2058	0.1844	0.1724	0.1738	0.1835	0.1809	0.1788
	g_{K25}	0.4640	0.4726	0.4795	0.5037	0.4625	0.4649	0.6256	0.6359
26	g_{L26}	0.3745	0.4192	0.4592	0.4351	0.4607	0.3223	0.3665	0.3725
	g_{T26}	-0.2640	-0.2747	-0.1298	-0.0572	-0.0523	-0.0312	0.0237	0.0317
	g_{R26}	0.7323	0.7259	0.5349	0.4756	0.4794	0.6193	0.5035	0.4941
	g_{K26}	0.1572	0.1296	0.1358	0.1465	0.1122	0.0897	0.1062	0.1018
27	g_{L27}	0.1934	0.1783	0.2744	0.2675	0.2683	0.2689	0.3253	0.3428
	g_{T27}	-0.0742	-0.0769	-0.0464	0.0024	0.0254	0.0210	-0.0090	-0.0330
	g_{R27}	0.7170	0.7617	0.5358	0.4303	0.4263	0.4331	0.3866	0.3560
	g_{K27}	0.1637	0.1369	0.2362	0.2998	0.2799	0.2771	0.2970	0.3342
28	g_{L28}	0.4695	0.5434	0.5992	0.5530	0.6258	0.5656	0.5094	0.5338
	g_{T28}	-0.2982	-0.4423	-0.3243	-0.1811	-0.1857	-0.1351	0.0838	0.0744
	g_{R28}	0.5883	0.6850	0.5320	0.4542	0.4070	0.4490	0.2904	0.2996
	g_{K28}	0.2405	0.2139	0.1931	0.1739	0.1529	0.1205	0.1164	0.0922
29	g_{L29}	0.6274	0.6556	0.6384	0.6719	0.7247	0.5331	0.5392	0.5516
	g_{T29}	-0.3110	-0.2944	-0.0945	-0.0580	-0.0811	-0.0662	0.0466	0.0463
	g_{R29}	0.5729	0.5661	0.3925	0.3330	0.3097	0.4866	0.3671	0.3625
	g_{K29}	0.1108	0.0727	0.0635	0.0532	0.0468	0.0464	0.0471	0.0396

	g_{L30}	0.6986	1.2069	0.8232	0.6378	0.8322	0.7529	0.5776	0.4753
30	g_{T30}	-0.3955	-1.2225	-0.4478	-0.2045	-0.4367	-0.2358	0.1209	0.2357
	g_{R30}	0.5327	0.8674	0.5145	0.4528	0.4979	0.3946	0.2349	0.2360

Appendix 2 Continuation Table

Industry code	g_{zj}	2005	2007	2010	2012	2015	2017	2018	2020
	g_{L31}	0.0761	0.0815	0.1119	0.1188	0.1390	0.5888	0.3769	0.4153
31	g_{T31}	0.0149	-0.0333	-0.0253	-0.0175	-0.0346	-0.4739	0.2017	0.2083
	g_{R31}	0.7494	0.8226	0.7504	0.7425	0.7751	0.5048	0.2460	0.2913
	g_{K31}	0.1597	0.1291	0.1630	0.1561	0.1205	0.3803	0.1754	0.0850
	g_{L32}	0.3607	0.4197	0.4461	0.4741	0.5434	0.5869	0.5693	0.5737
32	g_{T32}	-0.1437	-0.2042	-0.0819	-0.0681	-0.0964	-0.0707	0.0483	0.0583
	g_{R32}	0.6003	0.6533	0.5361	0.4799	0.4478	0.3952	0.2953	0.2944
	g_{K32}	0.1828	0.1313	0.0996	0.1141	0.1051	0.0886	0.0872	0.0737
	g_{L33}	0.4501	0.5835	0.5108	0.5409	0.6014	0.3657	0.4175	0.4222
33	g_{T33}	-0.1101	-0.1953	-0.0708	-0.0657	-0.0922	0.0249	-0.0211	-0.0237
	g_{R33}	0.4615	0.5069	0.3878	0.3572	0.3647	0.3732	0.3211	0.3245
	g_{K33}	0.1985	0.1049	0.1722	0.1676	0.1262	0.2363	0.2824	0.2770
	g_{L34}	0.3725	0.3736	0.4581	0.5237	0.5839	0.4390	0.4513	0.4512
34	g_{T34}	-0.1044	-0.0573	-0.0684	-0.0513	-0.0568	-0.0632	0.0450	0.0431
	g_{R34}	0.5979	0.5215	0.4927	0.4333	0.3966	0.5602	0.4350	0.4452
	g_{K34}	0.1339	0.1621	0.1176	0.0944	0.0763	0.0640	0.0686	0.0605
	g_{L35}	0.6007	0.6002	0.6460	0.6226	0.6699	0.6237	0.6104	0.6193
35	g_{T35}	-0.4279	-0.4057	-0.1053	-0.0630	-0.0815	-0.0610	0.0422	0.0440
	g_{R35}	0.6499	0.6293	0.3517	0.3316	0.3242	0.3576	0.2699	0.2743
	g_{K35}	0.1773	0.1763	0.1076	0.1089	0.0874	0.0796	0.0775	0.0624
	g_{L36}	0.5938	0.6406	0.6810	0.6903	0.6954	0.5569	0.5882	0.5876
36	g_{T36}	-0.0714	-0.1054	-0.0258	-0.0199	-0.0218	-0.0337	0.0246	0.0240
	g_{R36}	0.3789	0.4003	0.3103	0.2973	0.3034	0.4464	0.3534	0.3566
	g_{K36}	0.0987	0.0644	0.0344	0.0322	0.0231	0.0305	0.0338	0.0317

37	g_{L37}	0.4861	0.5465	0.5555	0.5506	0.5908	0.5168	0.5123	0.5163
	g_{T37}	-0.2099	-0.2262	-0.1060	-0.0716	-0.0890	-0.0617	0.0325	0.0323
	g_{R37}	0.6169	0.5928	0.4819	0.4579	0.4442	0.5016	0.3745	0.3807
	g_{K37}	0.1068	0.0869	0.0686	0.0631	0.0540	0.0432	0.0808	0.0707
38	g_{L38}	0.5288	0.5862	0.6111	0.6347	0.6644	0.5801	0.6012	0.5994
	g_{T38}	-0.0909	-0.1001	-0.0481	-0.0303	-0.0377	-0.0371	0.0256	0.0269
	g_{R38}	0.4610	0.4315	0.3675	0.3306	0.3178	0.4019	0.3142	0.3139
	g_{K38}	0.1011	0.0824	0.0696	0.0650	0.0555	0.0550	0.0590	0.0597