Digital Transformation: Reshaping China's Development Landscape

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Abstract: *The Chinese economy is currently undergoing a digital transformation. New growth drivers are replacing old ones, creating a new development landscape. Countries with strong digital industries will be the first to reap the benefits of digitalization. For China, the transformation to a digital economy is both of inevitability and heterogeneity fueled by dual circulations. Crowded out from more skill-based digitalized sectors, less-skilled labor moves to less digitalized sectors. New capital, industries and technology clusters emerge as new drivers of manufacturing and service sector development. With its large domestic market and industrial competitiveness, China has fostered a new development landscape of "dual circulations".*

Keywords: *digital transformation, shift from old to new growth drivers, "dual circulations" development landscape, re-industrialization of output value, service-based employment*

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1. Introduction

Since the beginning of industrialization, the world has experienced four major stages of industrial development, from mechanization (industry 1.0) to electrification (industry 2.0), automation (industry 3.0), and, finally, digitalization (industry 4.0). Advanced digital manufacturing technologies such as artificial intelligence (AI) and big data are fundamentally changing manufacturing attributes, integrating physical and digital manufacturing systems. Digital transformation will reallocate jobs based on intangible capital and technology clusters, and has profound implications for the economic landscape. The *Report to the 19th CPC National Congress,* delivered in October 2017, called for applying the internet, big data, and AI technologies as new growth drivers (Sheng, 2020). Digital transformation, which has become key for China's attainment of "industry 3.0," fosters new growth drivers for Schumpeterian "creative destruction".

After the founding of the People's Republic of China in 1949, China's economy experienced early-stage industrialization, economic adjustment through reform and opening up, and the development of an export-orientation (Dong and Li, 2020). In May 2020, in the context of the China-US trade war since 2017 and increasing technology competition, the Politburo Standing Committee called for the creation of a new development pattern of "dual circulations," which marked the beginning of the fifth stage of

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数字化转型如何助力构建新发展格局
——基于新旧动能转换的视角

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摘 要： *数字化转型、新旧动能转换和新发展格局形成都是当前中国经济正在经历的发展过程，三者之间存在紧密联系。全球来看，以高数字化产业为主导的国家将率先享受数字化红利。中国的数字化转型具有必然性和异质性，通过将低技能劳动力从高数字化部门挤出，流动到低数字化部门，带动资本、产业结构、产业空间和技术集群等方面的新旧动能转换，推动制造业产值“再工业化”和“就业服务业化”，促进形成强大国内市场，提高全球产业竞争优势，助力“双循环”新发展格局形成。*

关键词： *数字化转型；新旧动能转换；“双循环”新发展格局；产值“再工业化”；就业服务业化*

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一、引言

人类进入工业文明以来，经历了四个主要的工业发展阶段，分别是以机械化为代表的“工业1.0”、以电气化为代表的“工业2.0”、以自动化为代表的“工业3.0”和以数字化为代表的“工业4.0”。先进数字化制造技术，包括人工智能、大数据分析等，正从根本上改变生产制造的属性，使物理制造系统与数字空间制造系统趋于融合。数字化转型将带来就业重新配置、无形资本重要性提升、技术集群凸显等一系列变化，意味着经济发展方式发生重大转变。2017年10月党的十九大报告指出要推动互联网、大数据、人工智能和实体经济深度融合，培育新增长点（盛朝迅，2020）。这意味着数字化转型已成为中国打破“工业3.0”发展瓶颈，具有熊彼特“创造性破坏”意义的经济发展新动能。

新中国成立以来，中国经济发展主要经历了成立初期的早期工业化阶段、改革开放初期的国民经济调整阶段、外向型经济发展阶段和外向型经济发展格局调整阶段（董志勇和李成明，2020）。在2018年以来中美贸易战愈演愈烈，科技领域竞争趋势越发明显的背景下， 2020年5月中央政治局常委会首次提出构建双循环新发展格局，标志着中国经济发展全面进入第五阶段。这一阶段中，中国将依赖于国内产业体系外部经济优势

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China's economic development. In this stage, China aims to attract global innovation factors based on the strengths of domestic circulation and enhance its competitiveness in manufacturing and trade.

Amid China's digital transformation, new growth drivers are taking the place of old ones, giving rise to a new development pattern underpinned by the digital economy, digital industries, and digital applications. This paper explicates how digital transformation creates new growth drivers for China's economy as new businesses, markets, jobs, and industries emerge. Our conclusions provide policy-making references for China's 14th Five-Year Plan period (2021-2025) and beyond.

2. Implications of the Digital Transformation

2.1 Dividends from the Digital Transformation

Digital technologies based on big data enable seamless interoperability between smart machines, integrating the physical and virtual dimensions in manufacturing activity (Hong *et al*., 2019). Digital transformation brings great changes to business modes and methods. Verhoef *et al*. (2019) divided the change to the digital economy into the three stages of digital encoding, digital modeling, and digital transformation (Ye, 2020).

Stage I, digital encoding, refers to the digitalization of equipment and products. Stage II, digitalization, refers to the transformation of business processes through the use of digital technologies to increase efficiency. Stage III, digital transformation, involves the strategic changes of commercial operation modes. Each stage yields different dividends.

In Stage I, digital encoding promotes the innovation and improvement of products, provides new solutions to fringe groups, enables the mass manufacturing of customized products, and enhances the environmental performance of products.

In Stage II, digital modeling optimizes the manufacturing process and management performance. Green factories reduce emissions and waste. Flexible manufacturing enables supply chain connectivity, cuts operational costs, and increases the efficiency of capital by enhancing forecasting and automating maintenance, thus reducing downtime and excess inventory, and accelerating cash turnover. Digitalization also helps improve working conditions and work safety.

In Stage III, digital transformation creates new technical services and helps realize customer requirements by collecting and analyzing real-time data. Digital transformation propels the development of knowledge-intensive producer services and enables IT-based and digital solutions for smart manufacturing. New forms of social organization help the optimal reallocation of the factors of innovation and production. Digital technologies contribute to supply chain resilience, sophistication, and modernization.

Digital technologies have been applied extensively in fighting the COVID-19 pandemic and minimizing its impacts on people's lives and work in lockdown. Digital business modes have played a vital role in maintaining socio-economic stability (Wu *et al*., 2020). The value and potentials of digitalization have been fully recognized by China's policymakers. The CPC Central Committee's proposals for the *14th Five-Year Plan (2021-2025) for National Economic and Social Development and the Long-Range Objectives Through the Year 2035* have called for the development of digital industries, the application of digital technologies in traditional industries, and the integration of the digital economy with the real economy.

2.2 Opportunities and Challenges for China

Previous industrial revolutions were led by economies with early-mover advantage and followed by others with late-mover advantage. Which advantage dominates is determined by the innovation capacity and cost advantage of firms in the economy. The digital transformation of industries is often led by large companies. In the context of increasing industrial concentration, a country will occupy a vantage point

的充分支撑，形成多样化比较优势，以国内大循环吸引全球创新资源要素，向制造强国和贸易强国迈进。

数字化转型、新旧动能转换和新发展格局形成都是当前中国经济正在经历的发展过程，三者之间存在紧密联系。发展数字经济，推进数字产业化和产业数字化，是加快新旧动能转换构建新发展格局的重大战略举措。本文从企业、市场、就业、产业、空间等角度，论述数字化转型如何推动新旧动能转换、助力构建新发展格局，为“十四五”时期乃至更长时间政策制定提供决策参考。

二、数字化转型及其变动效应

（一）数字化转型的效益

先进的数字技术可以支持收集和分析海量数据，进行智能机器之间的无缝交互以及推动生产中物理和虚拟维度的组合（洪志生等，2019）。数字化转型是由数字技术引起的工作方式、组织方式甚至业务模式等全方位变化。Verhoef等（2019）将数字化转型分为三个阶段：数字化编码 (digital encoding)、数字化模型建构 (digital modeling)、数字化转型 (digital transformation)（叶飞，2020）。第一阶段的数字化编码 (digital encoding) 是指设备的数字化和产品的数字化。第二阶段的数字化模型建构 (digital modeling)是指使用数字技术来改变现有的业务流程，从而提高效率。第三阶段数字化转型 (digital transformation)则涉及数字商业应用模式的战略变化等。每一个阶段会带来不同的效益。

第一阶段来看，数字化可以促进产品创新，提供全新产品和改良产品；面向边缘群体，提供新解决方案；可以实现个性化产品、大规模定制；可以推动绿色产品设计，提高产品的环保性能。

第二阶段来看，数字化可以优化生产工艺，提高管理水平；推动绿色工厂建设，减少排放及废物产生；推进柔性制造，实现供应链互联，降低运营成本；提高资本利用率，包括加强预测和自动维护、减少停机时间、降低库存率、加快现金周转；改善劳动力就业质量，包括改善工作条件、提高工作安全性等。

第三阶段来看，数字化可以创造新的技术服务，可利用收集和分析实时客户数据的优势，直接参与客户需求的实现；推动知识密集型生产性服务业发展，实现智能制造所需的信息技术和数字解决方案；改变社会资源的组织方式，推动创新资源、产能资源的优化配置；提高产业链的韧性，推进产业基础高级化和产业链现代化的进程。

2020年伊始，突如其来的新冠肺炎疫情给中国经济社会带来严重冲击。在抗疫过程中，数字技术在疫情防控、生产生活保障领域得到广泛应用，数字化新业态、新模式加速普及，对稳定经济社会运转发挥了重要作用（吴静等，2020）。国家层面也意识到数字化巨大的价值和潜力。《中共中央关于制定国民经济和社会发展第十四个五年规划和二〇三五年远景目标的建议》提出，要加快数字化发展，推进数字产业化和产业数字化，推动数字经济和实体经济深度融合。

（二）中国的机遇与挑战

当前国际产业竞争日趋激烈。历史上的产业变革，都出现了领先经济体和跟随经济体，前者具有先行优势，后者具有后发优势。哪种优势起决定性作用取决于经济体企业创新能力与成本优势的此消彼长变化。产业的

in the global value chain (GVC) if it manages to lead the digital transformation. In emerging industries, late-movers may leverage digital solutions to become more competitive and increase their market share.

The degree of digitalization is reflected in robotic applications. When it comes to robotics, China is behind the world's most advanced levels. As early movers, Japan and South Korea lead the world in robotics R&D and applications. Despite its strengths in robotic manufacturing and applications, Europe is less competitive in robotics R&D. The United States leads the world in robotics R&D but does less well in robotic manufacturing and applications. With a huge market for digital applications, China's dominant sectors, such as automobiles and IT, boast a high density of digitalization. This digitalization helps Chinese companies increase their market share and change the country's position in the international division of labor. Research suggests that if China and South Korea which ranks first in terms of robotic density maintain their current growth rates, China will surpass South Korea in terms of the density of industrial robotics by 2026. To achieve the initiative in digital transformation, China should encourage its companies to develop critical technologies in robotics and digital equipment.

2.3 Digital Transformation: Heterogeneity and Transformative Effects

2.3.1 Firm heterogeneity

The diffusion of digital technologies in manufacturing is subject to firms' abilities to invest in and apply new technologies. The more firms develop and broaden these capabilities, the easier it becomes for them to implement digital technologies. Firm heterogeneity means that larger, more competitive and experienced firms are more likely to deploy digital technologies. Studies suggest that in Industry 3.0 and Industry 4.0 eras, big companies accounted for a higher share of companies that adopted digital manufacturing technologies. In Argentina, for instance, large manufacturers with more than 100 employees adopted 20% more Industry 3.0 and 4.0 digital technologies compared with the industry average. Efficiency gains and product upgrades from digital transition will help large firms become more competitive, giving rise to oligopolies and market concentration.

2.3.2 Sectoral heterogeneity

Efficiency gains from digital transformation vary across sectors. Some manufacturing sectors, such as process manufacturing, benefit more from the growth effects of digitalization than other sectors do (Gal, 2019).

Intersectoral differences of digitalization level can be measured by the density of digitalization, which is determined by various indicators, including the volume of online transactions and big data applications. The sectoral heterogeneity of digitalization means that natural differences exist in the digitalization densities of various sectors. Studies suggest that sectors with high digitalization densities include equipment manufacturing, computer, electronic, mechanical, and transportation equipment. The level of a country's digital transformation is correlated with its industrial structure. Countries whose dominant industries boast high digitalization densities are more likely to achieve digital transformation and reap the dividends from efficiency improvements.

2.3.3 Industrial chain changes arising from heterogeneity

From an industrial chain perspective, companies that use more robots may provide better intermediate products for downstream sectors, thus increasing competitiveness in their respective sectors and creating more jobs. Robotics and automation also generate demand for certain materials and components with positive effects on upstream sectors. Hence, digital transformation will ultimately induce the entire industrial chain to upgrade. According to Torste (2021), a country should encourage technology diffusion throughout industrial chains as it strives to catch up with more advanced countries. Technology diffusion helps late-moving countries increase innovation and industrial chain resiliency.

Digitalization brings about more cost reductions and efficiency gains in more digitalized sectors,

数字化转型往往由大企业推动。在当前世界范围内产业集中度逐步提升的背景下，哪个国家或者地区的大企业在数字化转型中能获得优势，提高生产效率，提升竞争力，就能推动所在的国家或者地区在全球价值链中占据主动。在一些新兴产业领域，各国的后发企业可以利用数字化的优势，提高竞争力，实现弯道超车，提高市场份额。

数字化程度的一个重要表现是机器人的应用情况。当前，中国在机器人的研发和制造方面落后于顶尖水平，处于第三梯队。第一梯队的日本和韩国是早期先动者，也是当今的全球领导者，无论是机器人研发还是应用都走在前列。第二梯队的欧洲在机器人制造和应用方面非常强大，但在机器人研发方面存在不足；美国在机器人研发方面具有稳固的竞争优势，但在机器人制造和应用方面相对薄弱。中国应用市场广大，主导产业中汽车、电子信息等产业数字化密度较高。这些行业中的企业近年来机器人应用呈现高速增长。中国主导产业企业的数字化水平提升，将有助于这些企业市场份额的提高，从而带动国家层面在国际分工中的地位改变。研究表明，如果中国和机器人密度排名第一的韩国都保持当前的增长速度不变，那么到2026年，中国将超过韩国，成为工业机器人应用密度最高的国家。中国要把握数字化转型的主动权，需要鼓励企业在机器人等数字化核心设备上加强关键技术攻关。

（三）数字化转型的异质性及变动效应

1.数字化的企业异质性

在企业层面，先进数字化制造技术的扩散依赖于企业是否具备各种必要能力，包括对应用新技术至关重要的投资能力、技术能力和制造能力等。企业能力累积的时间越长、规模与范围越大，越容易实施先进数字化制造技术。数字化转型的企业异质性意味着规模越大、能力越强、积淀越深的企业越倾向于多采用先进数字化制造技术。有研究证明，在工业3.0时代与工业4.0时代采用数字化制造技术的所有企业中，大型企业的比例更高。例如，在阿根廷，员工超过100名的大型企业对工业3.0与工业4.0数字化制造技术的采用率比所有企业平均采用率高出20%。由数字化转型带来的效率提升和产品升级，将推动大企业进一步巩固竞争优势，从而加剧寡头垄断和市场势力集中，形成强者愈强的局面。

2.数字化的行业异质性

由于不同行业在数字化转型后所带来的效率提升程度不同，数字化转型存在行业异质性，一些制造业部门数字化后增长效果比另一些制造业部门更加显著，比如流程性制造业（Gal，2019）。

行业之间数字化程度的差别可以用数字化密度衡量。这一指标基于在线交易规模、大数据应用程度等多个方面的情况。数字化的行业异质性意味着不同行业数字化密度之间存在着天然差别。研究表明，数字化密度高的行业包括装备制造、计算机、电子和机械运输设备等。一个国家数字化转型程度的高低与其产业结构存在密切关系。一些国家，由于其主导产业具有高数字化密度的特征，其制造业比其他国家更有可能实现数字化转型，享受数字化带来的效率提升红利。

where leading firms increase their dominant positions through mergers and acquisitions (M&As). Despite the monopoly effect, digital transformation allows firms to allocate resources on a broader scale at less cost and with fewer administrative barriers.

Digital transition gives rise to super stars, high-income jobs, and consumption upgrades. On the other hand, the low-skilled labor force becomes crowded out to less digitalized sectors, contributing to service sector prosperity. Higher wages for less-skilled labor force boost demand for low-end commodities.

3. Transition towards New Growth Drivers

As a new growth driver, digital transformation is expected to yield dividends in various areas, such as workforce competence, manufacturing value-added as a share of the economy, jobs in the service sector, city cluster integration, industrial diversity, reallocation effects, and dividends from structural change.

3.1 Labor Reallocation: Towards a Highly Skilled Workforce

From reform and opening up in 1978 to before the 2018 global financial crisis broke out, China experienced an unprecedented migration of medium- and low-skilled labor from the countryside to industrial and service sectors in cities, contributing to China's economic prosperity. With the reaching of the Lewis turning point, however, China's labor surplus is being replaced by a labor shortage. As the more educated workforce becomes employed in innovative sectors, many jobs have also been created for those less skilled. China's economic development is driven less by capital and more by the skill of the workforce. With the rising share of skilled workers in the workforce, skill upgrading has become integrated into the digital transition and improvement in productivity as a source of innovation-driven development.

Accordingly, China's labor policy is focused on transitioning from a low- and medium-skilled workforce driven by capital deepening to a highly qualified workforce driven by skills deepening. As a key feature of this stage, digitalization causes manufacturing to become more technology-intensive, thus generating a steep increase in the demand for a highly skilled workforce. The Communist Party of China and the Chinese government have resolved to improve the supply of human resources, as evidenced in a host of policy documents (Huang *et al*., 2019). In 2016, the CPC Central Committee released the *Opinions on Deepening Institutional Reforms and Expediting Innovation-Driven Development* and the *Opinions on Reforming Talent Development Mechanisms*. The Report to the 19th CPC National Congress called for "resolutely pursuing the strategy of building a strong nation through talent development". As China's digital transformation progresses, the need for a skilled workforce will increase at a faster pace, highlighting the demand for R&D, management, and technical professionals well-versed in digital trends and applications.

3.2 Capital Reallocation: Digital Capital Deepening and Capacity Sharing

Before the global financial crisis, China used cheap land, cheap labor, and other production factors to attract cross-border capital. In the past two decades, however, both land and labor have been increasingly scarce and pricey.

Digital transformation presents opportunities for digital capital, including digitally transformed industrial capacities and intangible assets arising from digital innovations, to become China's new strength in attracting foreign capital. The digital infrastructure has enabled capacity sharing. Through open platforms such as the industrial internet, manufacturing enterprises integrate discrete or idle resources to be more efficient. By re-organizing manufacturing resources and sharing capacity, countries may slash the cost of coordinating production factors, reshaping supply and demand (Tian, 2020). Intangible assets, including digital innovations, are a vital part of the modern economy. In China, 30% of

3.异质性带来的产业链变动效应

从产业链来看，使用更多机器人的企业可能为下游细分领域生产出更优质的中间产品，最终提高本产业链环节的竞争力，创造更多就业岗位。机器人使用的增加、生产过程自动化程度的提高还可能导致对某些材料和部件的需求增加，对本产业链环节的上游细分领域产生积极影响。因此，数字化转型将最终推动整个产业链的提升。Torste(2021)指出，在数字化带来的技术赶超过程中，应该鼓励产业链技术扩散，从而促进社会整体创新水平和产业链韧性的提高。

在数字化带来的产业链变动中，高数字化产业链环节成本降低更多，效率提升最快。这些环节的龙头企业有更多资源进行纵向和横向并购，导致资源进一步向这些企业集中，垄断性进一步加强。数字化转型在一定程度上形成产业垄断的同时，也会推动企业在全国乃至更大范围内配置资源，降低生产成本，从而进一步打破行政垄断。

最终，数字化转型一方面将在制造业领域造就一批巨型企业，形成一批高收入劳动力，扩大高端消费，推动消费升级；另一方面，将低技能劳动力从高数字化部门挤出到低数字化部门，为服务业的发展提供生产要素，促进服务业的繁荣，使低工资人群的待遇提升，从而带来低端商品的需求增加。

三、新旧动能转换的实现

数字化转型本身也是新旧动能转换的重要形式。数字化转型后，将带来劳动力、资本、结构、空间和技术的变化。这主要表现为制造业就业人员素质提高，增加值比例在国民经济中相对稳定甚至提升，服务业吸纳大量就业人口，城市群一体化，实现扩量提质，产业更具多样性，获取再配置效应和“结构变动红利”。

（一）劳动力再配置：从中低技能劳动力转移到高素质劳动力扩张

改革开放以来到2008年金融危机爆发之前，中国经历了史无前例的中低技能劳动力转移，推动了中国经济的繁荣。然而，中国的“刘易斯拐点”已经到来，由总体劳动力过剩向劳动力短缺转变，正进入劳动力再配置阶段，表现为高级劳动力向创新程度更高的行业集中，低技能劳动力实现广泛就业。经济发展由资本偏向性的创新驱动进入技能劳动力偏向型的创新驱动阶段。以高技能劳动力占比持续提升为特征的技能深化将融入数字化转型、生产力提升过程中，成为创新驱动的源泉。

与这种趋势相对应的，中国的劳动力政策，正由资本深化驱动的中低技能劳动力转移向技能深化驱动的高素质劳动力流动与供给扩张转变。制造业数字化作为这一阶段的重要特征，将促使生产变得更加技术密集，对高技能劳动力需求陡增。从2016年中央出台《关于深化体制机制改革加快实施创新驱动发展战略的若干意见》《关于深化人才发展体制机制改革的意见》，到党的十九大报告提出“坚定实施人才强国战略”，充分反映出党和国家对人才工作的重视及从源头提高人力资源要素供给质量的决心（黄群慧等，2019）。未来，随着数字化转型的深入，劳动力技能深化的进程将加速进行。具有原创能力的基础研究人才、理解数字化发展趋势的管理型人才、通晓专业知识和数字化工具的技能型人才将成为未来劳动供给深化的重要方向。

economic growth stems from intangible assets, which undergird China's structural upgrade and ascent in the global value chain (Tian *et al.*, 2016).

3.3 Industrial Structure Sophistication and Service Sector Employment

Industry, especially advanced manufacturing, underpins China's high-quality economic development (Wei and Wang, 2019). Digital transformation has led to sophistication in the supply chain of intermediate inputs and deepened China's industrial development. The manufacturing industry, which represents a rising share of China's economy, is becoming more competitive. After decades of industrial expansion at a shallow level, new technologies led by 5G, artificial intelligence (AI), industrial internet, and the internet of things (IoT) have brought opportunities for China to deepen industrial development. Advanced infrastructure has allowed smart manufacturing to thrive in China with more value-added than traditional manufacturing that creates the least value according to the smile curve theory. China's digital transformation holds great promise as a key driver of growth and structural improvement.

Digital transformation will bring prosperity to the service sector. Producer services, for instance, help a country raise manufacturing efficiency and climb up the GVC (Liu *et al.*, 2010). Manufacturing sophistication creates demand for more skilled and better-paid workers, crowding out less skilled ones to consumer services. As high-income groups expand, so will the demand for consumer services.

3.4 Rise of Manufacturing Goliaths

Digital transformation helps shape a broader network of factor flow and gives rise to iconic enterprises. With their central position in the supply chain, large firms attract more human, capital, and information resources. Investment in digitalization generates more performance improvement effects in large firms than in small and medium-sized ones. Large firms also receive more attention and support from government pilot programs to encourage digitalization (Chen and Huang, 2019). Digitally transformed enterprises are more likely to stay competitive and become iconic multinational goliaths. With the emergence of iconic firms, China will be better positioned to integrate global industrial resources, seize a high ground of technology, and enhance industrial competitiveness.

3.5 Transformation of Urbanization Mode: From Urban Sprawl to City Cluster Integration

City clusters are envisioned as the main form of China's new-type urbanization. With digital transformation, integrated city clusters are on the rise, replacing less efficient urban sprawl. Within city clusters, factors of production move freely (Tang, 2021). With smart cities come more openness and cooperation in city clusters featuring the efficient allocation of production factors.

Digital transformation will reshuffle city hierarchies based on the level of new infrastructure. Before the digital transformation, city hierarchies were determined by the density of traditional infrastructures such as roads and electric power. Industries tended to thrive in cities with more advanced traditional infrastructure. In the era of digital transformation, city hierarchies are more subject to the density of innovation factors like talents and capital. High-tier cities boast the best infrastructure and are home to high-end manufacturing and services. Less sophisticated manufacturing and services are concentrated in medium- and low-tier cities. By matching factors with industries, such specialization reduces the cost of the flow of people, goods, and information, facilitating innovation and economic activity.

3.6 Rise of Technology Clusters

Traditionally, industrial clusters refer to a group of correlated firms within a region; with close input and output correlations, those firms reduce the cost of production through specialization. As digital transformation deepens, cross-regional industrial clusters take shape. According to Zeng (2021), firms have attached greater importance to the results of innovation while striving to minimize the cost of production. Compared with formal relations of specialization among firms within geographical proximity, informal social relations have become increasingly important to knowledge flow and

（二）资本再配置：数字资本深化与产能共享

金融危机之前，中国吸引跨国资本的主要优势是廉价的土地、劳动力等生产要素。然而土地资源具有稀缺性，可供开发的产业用地越来越少；劳动力增量总体呈现下降趋势，成本越来越高。

数字化转型之后，中国吸引跨国资本的主要优势，将向优质的数字资本转变，主要包括数字化改造形成的产能资源和数字化创新形成的无形资产。前者是以新型数字基础设施为依托的制造业共享产能，也就是依托工业互联网等开放平台，围绕生产制造全过程的各个环节，通过整合配置分散或闲置的制造资源，实现生产效率提升后的产能。推进制造业产能共享，将不同制造资源进行拆分重组，可以大幅降低制造不同生产要素之间的协作成本，重构制造业的供需结构（田琛，2020）。后者主要是数字化创新网络支撑下的R＆D成果。无形资产是现代经济的基础。当前，无形资产对中国经济增长的贡献率约为30%，对于中国实现经济增长和结构升级，进行全球价值链攀升的作用日益凸显（田侃等，2016）。

（三）产业结构的复杂化：“产值再工业化”与“就业服务化”

当前，以先进制造业为主体的工业依然是支撑中国经济实现高质量发展的重要动力（魏后凯和王颂吉，2019）。“产值再工业化”指通过数字化转型推进中国制造业中间产品产业链网络进一步复杂化、根植性进一步增强，从“浅度工业化”向“深度工业化”迈进，带动经济中制造业比例回升和质量升级。“产值再工业化”背后的机制是立足“体系完备”的制造业深化和新型基础设施支撑下的制造业升级。前者指中国经济将由以扩展性工业化为代表的浅度工业化向以内涵型工业化为代表的深度工业化演进。后者指的是5G、人工智能、工业互联网和物联网等新型基础设施的建设为以数字化转型为代表的深度工业化提供了契机。新基建正成为稳定经济增长和优化经济结构的有效着力点。一些制造业大省以新型基础设施为支撑，发展以智能制造为核心、具有高附加值性质的高端制造业，有可能颠覆传统“微笑曲线”理论关于制造环节附加值最低的定论，带来经济结构中制造业比例的回升。

数字化转型对于服务业的发展也将产生深远影响，将推动服务业走向繁荣。对于生产性服务业来说，其本身同先进制造业存在共生共荣、互相促进的关系。生产性服务业为先进制造业提供高质量的专业服务，提高制造业各环节的生产效率，推动制造业的全球价值链攀升（刘明宇等，2010）。制造业对生产性服务业需求的提高有助于生产性服务业效率的改善。对于生活性服务业来说，一方面，制造业向高端攀升将推动劳动力需求升级，部分劳动力将从制造业中挤出到生活性服务业，为生活性服务业提供劳动要素。另一方面，制造业攀升带来的高收入人群将扩大对于生活性服务业的需求，带动生活性服务业市场扩容和质量提升。

（四）产业地标化的出现：大企业可持续竞争力的提升

数字化转型将推动更广范围内资源流动网络的形成，带动中国企业结构的变化，推动形成更多的地标企业。这一方面由于大企业居于产业链的中心地位，汇聚更多的人才、资金、信息资源，对于大企业进行数字化投入的绩效提升作用超过中小企业；另一方面也是因为在政府通过试点示范等途径对企业进行数字化投入的奖励中，大型龙头企业得到的关注和实际扶持力度较大（陈畴镛和黄明月，2019）。数字化转型后，大企业相

innovation over the past two decades.

As innovation takes on the trait of cross-regional digitalization, the density of digital infrastructure becomes a key driver of industrial agglomeration, and cost reduction is no longer the sole consideration. Increasingly linked with external economies, industrial clusters generate spillover effects in a broader range. Regional innovation and industrial centers form an ecosystem of hierarchical specialization. Within technology clusters, a new center-periphery relationship takes shape. While central cities generate original and more sophisticated innovations, the commercialization of original and derivative patents takes place in peripheral cities. Digital transformation drives the evolution of industrial clusters towards technology clusters where R&D and commercialization take place in synergy.

The rise of technology clusters prompts China's ascent from medium- and low-tech competition to high-tech competition. According to the World Bank, China's manufacturing industry generated a value-added of 625.22 billion US dollars in 2004, accounting for 8.6% of the world's total, or 38.8% that of the United States. In 2017, China's manufacturing value-added was 1.6 times that of the United States, or 27.1% of the world's total. In 2018, this percentage further rose to 28.3% (CASS Institute of Industrial Economics Research Group, 2020). Despite its industrial heft, however, China is dependent on overseas supplies of critical technologies. After the transition from price advantage to the advantage of scale, China is at a critical threshold of fostering new strengths of innovation. In this process, the evolution from advanced manufacturing clusters to technology clusters is vital. The development of technology clusters requires an abundance of knowledgeable and skilled workforce with problem-solving skills. Foreseeably, future investment in advanced manufacturing tends to take place in universities and research institutes rich in intellectual resources.

4. Formation of "Dual Circulations"

According to the CPC Central Committee's proposals for the 14th Five-Year Plan (2021-2025) for *National Economic and Social Development and the Long-Range Objectives Through the Year 2035*, China's current priority is to foster the development of domestic and international "dual circulations" taking advantage of its domestic market strengths and its status as a competitive trading nation. Digital transformation will play an important role for that.

4.1 Domestic Circulation: Towards a Strong Domestic Market

The 14th Five-year Plan period is critical for China's transition from high-speed growth to high-quality development. Given the complex and challenging international situations, this transition cannot be accomplished without a strong domestic market, which is extremely important in China's development into a modern socialist nation (Wang and Liu, 2020).

By integrating the manufacturing and service sectors, digital transformation expedites the formation of a strong domestic market. Digital technologies create jobs in high-tech manufacturing sectors that take the place of those in low-tech ones. In the service sector, digital technologies create jobs for the less skilled, contributing to service sector employment. In this manner, the digital transformation retains our low-cost labor advantage and expands the demand for a less skilled workforce. In addition, the digital transformation triggers consumption by increasing wages for the skilled workforce. The final result is diversification in China's comparative advantages, including low-cost labor and a more skilled workforce, and a robust domestic consumer market underpinning the domestic circulation of goods.

4.1.1 Digital technologies facilitate supply-demand matching in the supply chain and increase wage premiums for the skilled workforce

Digital transformation boosts manufacturing productivity by transforming business modes. In the era of the mobile internet, digital technologies transform business modes for manufacturing enterprises

对更容易提升可持续的竞争力，一部分龙头企业将成为跨领域、跨国界的地标性企业。地标性企业的出现，将有利于中国整合全球产业资源，占据技术制高点，提高产业影响力，实现产业发展由大到强的转变。

（五）城市化的模式转变：从“边际扩展”转向城市群一体化

国家新型城镇化规划提出城市群是中国未来城镇化的主体形式。经济的数字化转型将推动城市布局更加高效，促进从“边际扩展”的城市化向城市群一体化转变。城市群一体化本质上要求生产要素在城市群内部自由流动（唐为，2021）。随着数字化转型的深入，新型智慧城市的发展将推动城市群的开放合作程度大大加深，有利于形成城市群级别的生产要素大市场，促进区域内要素的自由流动和合理配置。

同时，数字化转型将有利于形成以新型基础设施级别为依据的城市级别体系。在浅度工业化时代，城市级别的划分更多依据传统的道路、电力等基础设施的密度。中心城市拥有更加发达的传统基础设施，可以促进更多产业集聚。在深度工业化时代，城市级别的划分更多取决于人才、资本等创新要素的密度，而这与新型基础设施的分布息息相关。数字化程度高的高端制造业和服务业集聚在高等级城市，数字化程度低的低端制造业和服务业集聚在低等级城市，数字化程度中等的制造业和服务业则集聚在中等城市。这样根据数字化密度形成的城市群体系，将实现要素与产业更高程度的匹配，降低人流、物流、信息流、交通流的成本，更加有利于创新和生产活动的展开。

（六）技术集群的兴起：新型产业化等级体系的形成

数字化转型将改变产业集群的内涵。在工业化进程中，产业集群普遍存在。传统的产业集群一般是一定地理范围内有关联的企业群体，拥有密切的投入产出联系，注重专业化分工引致的生产成本降低。然而，随着数字化转型的深入，集群构建体现出跨区域的特点。究其原因，曾婷（2021）研究发现，企业在追求生产成本降低的同时，开始更加重视技术创新的成效。相对于正式的具备地理邻近性的专业联系，由数字化手段构建的非正式社会关系对知识流动和创新的影响在过去二十年中变得越来越重要。

当创新具备跨区域数字化的特点之后，产业集群的集聚逻辑发生变化，表现为根据数字基础设施密度进行集聚，而不是单纯依赖于降低成本进行集聚。集群外部经济的范围扩大，外溢效应在更广范围内形成，在区域内形成技术创新和产业基地的梯度层级，围绕创新中心形成技术和产业体系。在新型基础设施的支撑下，技术集群内部呈现出新型的“中心—外围”关系。中心城市从事原始创新等更高等级的创新活动，外围城市进行产业化创新。中心城市产生原创性专利，衍生的应用型专利在外围城市形成，技术向外围地区扩散，产业化则在更加边缘地带形成。数字化转型推动分工协作的产业集群向产学研协同的技术集群演变。

技术集群的兴起有利于促进中国从中低技术产业竞争进入高技术产业竞争。根据世界银行的数据，2004年，中国制造业增加值6252.2亿美元，占世界制造业增加值的8.6%，仅相当于美国的38.8%；2017年，中国制造业增加值相当于美国的1.6倍，占世界的27.1%，2018年进一步提高到28.3%（中国社会科学院工业经济研究所课题组，2020）。然而，中国工业总体上仍然“大而不强”，表现为一些重点产品领域存在“卡脖子”“掉链子”的问题，一些关键核心技术仍受制于人。当前，中国工业在完成了由价格优势向规模优势的转变后，正处

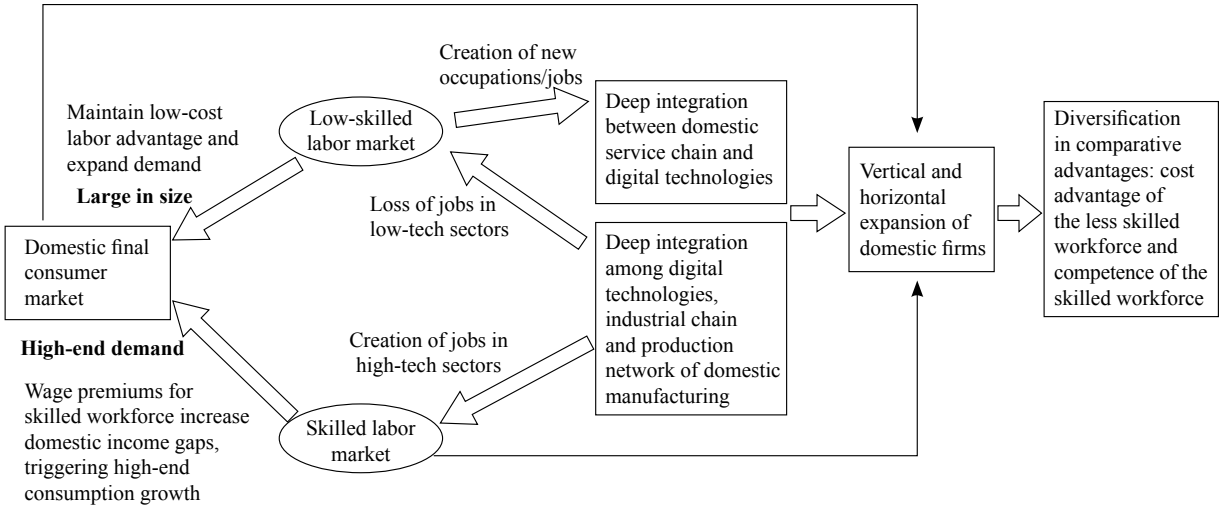

Figure 1: Domestic Circulation Based on the Digital Transformation

to become more efficient and competitive (Liu, 2020). Some academics found that digital transformation could boost total factor productivity (TFP) in manufacturing through technology empowerment. Others believed that digital technologies could promote economic growth through substitution and penetration effects (Hu, 2019). Another important effect of digital transformation is more precise and efficient matching between supply and demand. Interactions between industrial and consumer internet make it easier for the supply side to capture and respond to demand-side changes by coordinating factors of production. Successful digital transformation will help increase manufacturing productivity and value-added.

Rising manufacturing productivity will result in higher wages for the skilled workforce. Considering the limited cross-border flow of labor (Liu, 2021), these wage benefits are more reflective of a country's actual gains from GVC participation. Wage premiums for the skilled workforce will boost high-end consumption.

4.1.2 Digital applications help maintain China's advantage of low-cost labor in the service sector

As digital transformation deepens, low-skilled workers are crowded out from the manufacturing sector and become employed in the service sector. Academic debates over the "service sector puzzle" can be traced back to the famous Baumol-Fuchs Hypothesis, i.e., relative price increases in the service sector despite a significant lag in service sector productivity growth compared with industrial sectors (Han and Fu, 2019).

Yet the service sector puzzle has a potential solution. After digital transformation, online and offline service integration and service modularization will hold sway, creating more and better jobs and contributing to consumption growth. The effects are threefold:

First, employment absorption effect: With more high-income manufacturing jobs comes a greater consumer base for the service sector, which hires less-skilled workers crowded out from the manufacturing industry. Labor supply and demand are precisely matched utilizing digital applications.

Second, employment optimization effect: Access to digital information increases labor market efficiency by reducing information frictions. By increasing transaction volumes, digital platforms make it more likely for workers to earn higher incomes and benefits.

Third, consumption effect: Through big data analysis, modern services identify implicit consumer

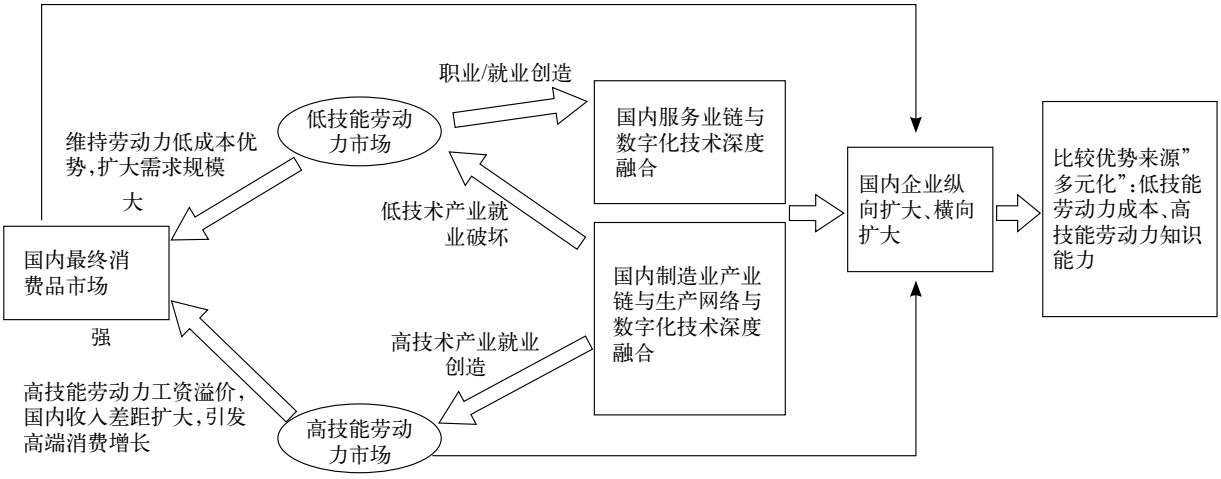

图1 数字化转型促进形成国内大循环的机制

于进一步向创新优势转变的重要时期。推动先进制造业集群向技术集群演变非常重要。技术集群发展需要大量掌握相关知识和技能，具备分析和解决问题能力的人才。未来，先进制造业的投资将趋向于高校科研院所等智力资源密集的地方。

四、"双循环"新发展格局的最终形成

《中共中央关于制定国民经济和社会发展第十四个五年规划和二〇三五年远景目标的建议》提出，立足国内大循环，协同推进强大国内市场和贸易强国建设，形成全球资源要素强大引力场，促进内需和外需、进口和出口、引进外资和对外投资协调发展，加快培育参与国际合作和竞争新优势。数字化转型在这一进程中将发挥重要作用。

（一）国内大循环：国内市场强大的机制

"十四五"时期是中国经济从高速增长转入高质量发展的攻关期，迫切需要以加快形成强大国内市场为核心促进国内大循环。这既是应对国际严峻复杂形势的关键之举，也是开启全面建设社会主义现代化强国新征程的战略举措（王微和刘涛，2020）。

数字化转型将通过与国内制造业和服务业产业链的深度融合，加快强大国内市场的形成。数字化技术与制造业产业链深度融合，形成高技术产业就业创造和低技术产业就业破坏效应，一方面扩大高技能劳动力市场规模，另一方面挤出低技术产业的劳动力到低技能劳动力市场。数字化技术与服务业深度融合，产生低技能劳动力的就业创造效应，匹配服务业需求和供给，扩大服务业就业规模。这样，数字化转型一方面维持了劳动力低成本优势，扩大了低技能劳动力需求；另一方面提高了高技能劳动力的工资溢价，引发高端消费增长。最终，中国将实现比较优势来源"多元化"，构成低技能劳动力成本、高技能劳动力知识能力双优势，建成大而

demand and are less vulnerable to climate and public health incidents, as can be evidenced in strong demand for online education, shopping, and healthcare during the COVID-19 pandemic. Amid the digital transformation, modern services have created sufficient jobs for the low-skilled workforce, maintaining China's advantage of low-cost labor.

4.2 International Circulation: Securing the Most Advantageous Position in the Global Value Chain

Amid the digital transformation, new growth drivers take the place of old ones. This will result in the diversification of China's comparative advantages, including low-cost and both a highly skilled workforce and less skilled labor. In transitioning into a technology powerhouse, China will be a better position for two-way investment in high-tech sectors and in the two-way flow of the workforce. As a competitive trading nation, China will invest in medium- and low-tech sectors in emerging countries and import their goods and raw materials.

4.2.1 China and developed countries: Two-way investment in high-tech sectors and two-way flow of skilled workforce

Rising total factor productivity (TFP) and progress in technology-intensive sectors will significantly increase a country's trade openness. China is reforming higher education to train professionals well-versed with the digital economy. Incentives have been offered to encourage firms to reap dividends from digitalization and become champions in their respective sectors by improving product quality and value-added and deepening competencies. With digital transformation and the development of technology-intensive sectors, China will take steps to enhance supply chain security and become less dependent on sophisticated intermediate inputs from Western countries. Indigenous innovation will yield dividends for China's productivity improvement.

4.2.2 China and emerging developing countries: Import of medium- and low-tech goods and raw materials and investment in medium- and low-tech sectors

After World War II, international industrial relocation has occurred in three big waves. Following evolving comparative advantages, China's coastal regions have started to invest in medium- and low-tech sectors in Southeast Asia, South Asia, and Africa. China shares a similar factor endowment structure

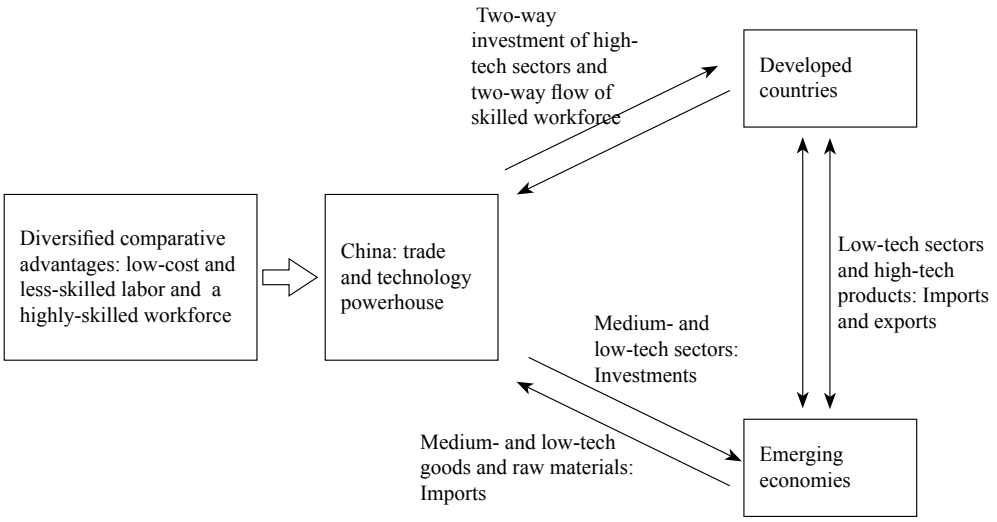

Figure 2: International Circulation Based on Digital Transformation

强的国内终端消费品市场，形成国内大循环（见图1）。

1.国内制造业产业链与数字化技术深度融合，供给匹配需求更加精准，高技能劳动力工资溢价增加

数字化转型对制造业生产率存在三个维度的作用机制，即数字化投资、数字化应用和业务模式转型。随着互联网移动端时代的来临，数字化转型对制造业的作用机制正从浅层次的数字化投资和应用向深层次的业务模式转型变化，助推制造业企业高质量发展（刘飞，2020）。此外，有学者研究发现数字化转型对提高制造业效率存在显著效应，可以通过技术赋能提高全要素生产率；也有学者认为数字技术通过替代效应和渗透效应促进经济增长（胡俊，2019）。数字化转型对制造业还存在一个更加重要的影响，即推动供给和需求的匹配更加精准和快速。通过工业互联网和消费互联网的联动，供给侧将更加容易捕获需求侧的变动信息，更好地协同生产要素，快速对其做出准确响应。这也将进一步推进数字化转型成功地区制造业生产率的提高和附加值的上升。

由于劳动力的跨国流动性较低（刘维林，2021），随着制造业生产率的提高，高技能的先进制造业劳动力所获得的回报将更能够体现本国参与全球价值链的实际收益，获得更高的工资溢价，产生相对于低技能劳动力的更大工资差距，引发高端消费持续增长。

2.国内服务业产业链与数字化技术深度融合，维持低技能劳动力低成本优势

随着数字化转型向纵深推进，大量低技能劳动力将从原先的制造业部门中被挤出，进入服务业就业。长久以来，学界一直研究“服务业之谜”，可以追溯到著名的鲍莫尔—富克斯假说，主要内容是服务业的劳动生产率与工业相比具有明显滞后性，但相对价格却不断上涨（Han and Fu，2019）。

然而，服务业之谜有可能被破解。数字化转型后，服务业成为打通线上与线下的现代服务业，各种业态被模块化。整个产业发生转变，产生了就业吸纳、就业优化和消费扩大三种效应。一是就业吸纳效应。得益于制

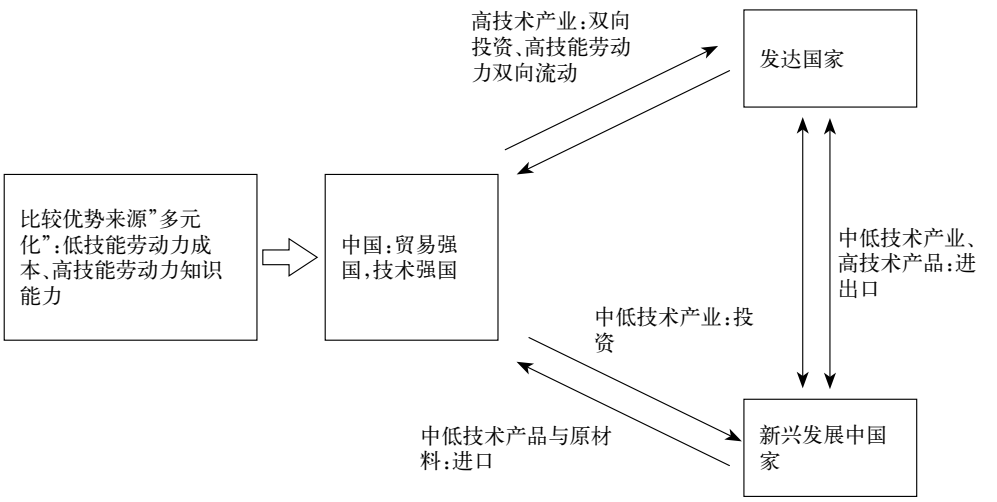

图2 数字化转型促进形成国际大循环的机制

with most Belt and Road countries. Digital applications will broaden China's cooperation with emerging economies. By importing medium- and low-tech goods and raw materials from emerging economies, China creates a global supply chain for all sorts of products and inputs. By investing in medium- and low-tech sectors in emerging economies, China achieves the optimal allocation of industrial capacity based on digital applications. When it comes to innovation, China stands ready to join hands with emerging economies for R&D endeavors. As digital transformation deepens, China will improve its GVC position towards high-end links.

4.2.3 Digital transformation propels China's strengths in trade and technology

In history, the rise of trading powers was often accompanied by technological revolutions. The WTO's *World Trade Report 2018* notes that digital technologies are transforming the fundamental landscapes of global trade. Digital technologies play a vital role in China's technological, industrial, and trade competitiveness. In November 2019, the Chinese government enacted the *Opinions on Advancing High-Quality Trade Development*, vowing to accelerate digital trade development and increase trade digitalization.

In international trade, leading trading nations dominate rules-making. To join the rank of trading powers, a country must possess three core capabilities. First, it must be able to allocate resources globally. Cross-border capital flow and M&As are key avenues for countries to develop capabilities for international resource allocation. Second, its home currency must circulate globally. The reason is that the pricing power over goods and services in international exchange stems from not only a country's volume of trade in goods and services but the internationalization of its currency (Pei and Liu, 2017). Third, it must be able to provide global public goods, including international rules and operational vehicles (such as the World Bank, the IMF, and G20).

The establishment of a digitalized economic system will help China acquire the above-mentioned three core competencies for more efficient product, technology, and capital exchanges at a higher level. By relocating manufacturing capacities to Belt and Road countries according to their resource factors, China will match industrial layout with regional endowment and thus optimize value chain distribution. In deepening cooperation with developed countries, China will effectively access factors of innovation, including technology, human resources, and capital. By importing more medium- and low-tech goods and exporting more high-tech goods, China is poised to transition towards a powerhouse of trade and technology and bring into shape a new development pattern featuring domestic and international dual circulations.

5. Conclusions and Policy Implications

Due to its supply chain effects, digitalization will cause massive shifts in the relative economic strengths of countries and regions. Currently, China is implementing development concepts and forming a new development pattern. In this critical stage, we must be aware of the effects of digital transformation on labor and capital reallocation, including the need for adjustment in the industrial structure, and the rise of technology clusters. We must seize the opportunity to develop high-end manufacturing, modernize the supply chain, and increase service-based employment. The ultimate goal is to strengthen and expand the domestic market, increase industrial global competitiveness, and foster a new development pattern of "dual circulations".

In the 14th Five-Year Plan period (2021-2025), China must prioritize new infrastructure, the industrial internet, the protection of intangible assets, and smart manufacturing for the early completion of the digital transformation.

造业高收入人群的扩张，服务业市场规模得到扩大，可以吸纳从低技术制造业中转移过来的大量劳动力，并通过数字化手段精准匹配需求。二是就业优化效应。消费需求与劳动力供给的数据有效对接，将提高劳动力市场的匹配效率，降低不必要的信息摩擦，有效稳定劳动力市场。数字化平台提高商户交易额，为提高劳动者收入报酬、改善福利待遇提供了可能性；推动工作流程更加标准化、工作岗位职责更明确，为提高商户的效益和提升劳动者就业能力提供了可能性。三是消费扩大效应。现代服务业可以通过大数据分析，挖掘消费者的隐性需求。同时，现代服务业受到天气、疫情等的影响大大减小。疫情期间，线上教育、购物、医疗等需求不降反增就是有力证明。这样，数字化转型后的现代服务业为大量低技能劳动力就业提供了稳定的空间，维持了中国低技能劳动力的低成本优势。

（二）国际大循环：形成“以我为主的全球价值链”

在完成数字化转型和新旧动能转换后，中国将形成比较优势来源“多元化”，同时具备低技能劳动力成本和高技能劳动力知识能力双优势。一方面，中国将有条件与发达国家进行高技术产业的双向投资和高技能劳动力的双向流动，向技术强国迈进；另一方面，中国将在新兴发展中国家进行中低技术产业投资，并进口中低技术产品和原材料，向贸易强国迈进（见图2）。

1.中国与发达国家：高技术产业双向投资、高技能劳动力双向流动

一国全要素生产率提升、技术密集型行业进步将显著促进贸易开放。当前，中国正一方面推动高等教育的供给侧改革，面向实体经济的发展和数字化转型的需求重新设定培养方案；另一方面鼓励企业更多争取“数字化红利”，提高产品质量，提升附加值，深耕细分领域，成为行业的隐形冠军。随着数字化转型的深度进行和技术密集型行业的发展，中国将逐步提升产业链安全可控水平，降低对西方国家高端中间品的过度依赖，强化自主研发创新，积累庞大的中高端智力队伍。“工程师红利”“数字化红利”成为中国生产率提升的关键依托，与发达国家将实现双向投资和高技能劳动力的双向流动。

2.中国与新兴发展中国家：中低技术产品与原材料以进口为主，中低技术产业以投资为主

“二战”以后，世界上共形成了三次大的产业梯度转移浪潮。当前，中国大陆沿海向东南亚、南亚及非洲等地区进行中低技术产业投资，进口中低技术产品和原材料，是对比较优势演进规律的遵循。中国同大多数“一带一路” 发展中国家的要素禀赋结构类似。数字化手段的广泛应用将扩大中国与新兴发展中国家的合作。一是产业链合作，中国从“一带一路”国家进口中低技术产品与原材料，在全球范围内完善高中低产品梯度配置；二是产业链投资，中国对新兴发展中国家进行中低技术产业投资，并通过数字化手段实现产能的优化配置；三是优势科技创新合作，中国可以用数字化手段，整合新兴发展中国家的创新资源，组织共同研发。总之，随着数字化转型的深入推进与新旧动能转换的进行，中国将完善自己的全球价值链，实现向产业链高端迈进。

3.数字化转型推动中国由贸易、技术大国向贸易、技术强国的转变

根据历史规律，贸易强国的崛起往往伴随着技术体系的变革。WTO《世界贸易报告2018》指出，数字技术正在改变全球贸易根本图景。应用数字技术提高国家的技术竞争力和产业竞争力是成为贸易强国的关键。

5.1 New Infrastructure: A Key Entry Point for Digital Transformation

The infrastructures of big data, 5G communication, and artificial intelligence (AI) are the foundation for the digital transformation. The new infrastructures will expedite industrial development at a deeper level characterized by the penetration of smart manufacturing in various sectors. Industrial sophistication is essential for service sector upgrades and high-quality economic development.

5.2 Investment and Protection of Intangible Assets

For the industrial internet, digital resources are as important as the digital infrastructure. Innovation and R&D are priorities for industrial investment in the new era. Policy incentives must be offered to increase investments in both physical infrastructure and intangible assets. In addition to new infrastructure, we should build up intellectual strengths for increasing industrial development. In addition, we should attach importance to the role of intangible assets, especially intellectual property rights (IPRs), protect IPRs, and standardize IPR transactions.

5.3 Guiding Labor Reallocation

Digital transformation will have labor redistribution effects across industrial sectors. We should improve digital education and train digital professionals for advanced manufacturing and producer services. We should guide less-skilled workers to be re-employed in less digitalized sectors such as consumer services, enhance their professional skills, enrich service sector categories, and promote service sector prosperity.

5.4 Developing an Industrial Spatial Layout Compatible with Digital Resources

In the era of city cluster integration, digital and intellectual endowments will replace the costs of transportation and transaction as key drivers of industrial layout. Within city clusters, digital infrastructure will induce original and applied innovations and facilitate the commercialization of R&D results. From an international circulation perspective, we should attach equal importance to traditional and new infrastructures under the Belt and Road Initiative (BRI), giving prominence to the exchange of professionals. China should develop an international circulation of industries, talents, and innovations by creating innovation incubation centers digitally connected around the world.

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2019 年11 月《关于推进贸易高质量发展的指导意见》提出，要加快数字贸易发展，提升贸易数字化水平。

在国际贸易活动中，贸易强国在规则制定上拥有较强的话语权。成为贸易强国需要具备三项核心能力：一是在全球范围内配置资源的能力。跨国资本流动和跨国企业并购是形成国际化配置资源能力的重要途径，也是实现全球范围资源配置的主要形式。二是本国货币在世界的流通能力。这是因为国际交换中商品和服务的定价权除了来自一国商品和服务的贸易量，还来自该国货币在世界的流通水平（裴长洪和刘洪愧，2017）。三是提供全球公共产品的能力，包括国际规则、运行载体（包括世界银行、IMF 和G20 等）等。

数字化经济体系的全面建立，将助力中国获得以上三个核心能力，提高产品、技术、资本交流的效率和水平。首先，利用中国制造业产能优势，在推动产业和产品生产环节向“一带一路”沿线国家梯度转移的同时，对“一带一路”沿线国家能够更好地根据资源要素进行细分，做到产业布局和地区禀赋的高度匹配，从而优化价值链的分布。其次，加深与发达国家的协同合作，与发达国家在技术、人才、资本等方面更加有效和平等地进行对接，在利用全球创新要素中实现创新、突破和升级。最终，中国将扩大中低技术产品进口、高技术产品出口，实现从技术大国向技术强国的转变，形成以国内大循环为主体、国内国际双循环相互促进的新发展格局。

五、结论与启示

数字化通过作用于不同企业，带来产业链的变动效应，引起国家和地区经济实力此消彼长的变化。中国正处于贯彻新发展理念、构建新发展格局的关键时期，需要认识到数字化转型在推动劳动力再配置、资本再配置、产业结构变化、技术集群兴起等方面的作用和趋势，抓住机遇，实现产业基础高级化和产业链现代化，推进制造业高端化和增加服务业、就业吸纳能力，最终巩固和扩大国内市场，提高全球产业竞争优势，推进“双循环”新发展格局形成。

具体来看，在“十四五”期间，中国需要在新型基础设施建设、工业互联网发展、无形资产保护、智能制造推广等方面完善相关政策，推进数字化转型早日实现。

1.将新型基础设施作为数字化转型的重要突破口

大数据、5G、人工智能等新型基础设施是数字化转型的基础。传统基础设施支撑了浅度工业化的进行，新型基础设施将大力推进深度工业化的进程，支持智能制造在各个产业形成穿透和串联。只有深度工业化顺利进行，服务业的升级才有依靠，经济的高质量发展才有保障。

2.促进数字化转型后无形资产的投资和保护

新型基础设施解决了深度工业化的硬件问题，但基于工业互联网的数字资源开发同样重要。创新、研发是新时代产业投资的重点。在进行大量实物投资的基础上，政策同样要鼓励无形资产的投资，形成新型基础设施之上的智力基础设施，构建支撑深度工业化的工业大脑。同时，要重视以知识产权为代表的无形资产的重要作用，大力推进知识产权的保护和规范化交易。

3.加强劳动力再配置的引导

数字化转型的深入展开将产生不同产业部门的劳动力再配置效应。要推进数字化相关教育的完善，扩

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大高端人才队伍，引导高端人才向数字化程度高的先进制造业和生产性服务业部门集聚；引导从制造业中挤出的劳动力向生活性服务业等数字化程度低的部门流动，加强职业技能培养，丰富服务业种类，推进服务业繁荣。

4.推动形成与数字资源更加匹配的产业空间布局

从国内大循环视角看，在城市群一体化时代，产业的空间布局原则将发生改变，由根据交通成本、交易成本布局，转为按照数字禀赋和智力禀赋来布局。可以通过数字基础设施的建设引导产业布局更加合理，推进在城市群内部形成协同分工、高效有序的“原始创新—应用创新—产业化”空间体系。从国际大循环的视角看，要推进“一带一路”向传统基础设施和新型基础设施建设并重转变，更加重视人才一体化基础上的创新互联。建议建设一批数字化联通的创新孵化基地，推动国际大循环由产业的大循环向人才的大循环，最终向创新的大循环演进。

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