中国产业转型升级取得里程碑式进步

中国社会科学院工业经济研究所课题组*

摘　要：近年来，中国不断推进经济高质量发展，推动由“中国制造”向“中国创造”迈进，产业转型升级步伐明显加快，取得里程碑式进步。在要素禀赋结构方面，创新投入和创新能力实现大幅度跃迁，从“人口红利”到“人才红利”的转型实现质的跃迁，新型基础设施规模已处于全球第一梯队。在关键前沿技术研发方面，5G、深海、航天、交通、能源等重点领域取得一系列突破性进展。在新兴高端产品生产方面，实现新产品和智能产品快速增长，中国已成为全球最大的机器人市场。在产业结构变迁方面，中国经济已进入服务业主导发展阶段，同时服务业内部的生产性服务业占比提高，技术密集型、知识密集型服务业快速增长，高新技术产业成为拉动经济增长的关键动能，一二三产业融合、数实融合成为重要发展趋势。在数字经济发展方面，规模和渗透率快速增长，“数据要素×”和“人工智能＋”正助力产业转型升级，智能制造、电子商务、网上销售等新业态新模式发展迅猛。在绿色经济发展方面，已初步建立起绿色现代化产业体系，新能源产品生产居于全球领先地位，可再生能源发电已成为新增装机的主体。在产业国际化方面，高新技术产品出口成为主导产品，中国对外直接投资已位居世界前列，产业国际化逐渐实现从“走出去”到“融进去”的跨越式发展。

关键词：产业转型升级　里程碑式进步　关键前沿技术　数字经济　绿色经济
JEL 分类号：O10

2010年，中国GDP首次超越日本，成为世界第二大经济体。同年，中国制造业增加值也首次超越美国，成为世界第一制造大国。此后，中国稳居世界第二大经济体和世界第一制造大国的位置。近年来，中国持续推进经济高质量发展，推动从“中国制造”向“中国创造”的转变，产业转型升级步伐明显加快，取得里程碑式进步，“中国创造”的力量日益彰显，突出表现为要素禀赋结构实现新跃迁、关键前沿技术研发取得新突破、新兴高端产品生产迈上新台阶、产业结构高级化跨入新阶段、数字经济发展塑造新动能、绿色经济发展创造新奇迹、产业国际化迈出新步伐。

一、要素禀赋结构实现新跃迁

（一）创新投入和创新能力显著提升

据统计，2012~2023年，中国全社会研发经费支出从1.03万亿元增至3.33万亿元，研发投入强

* 联系人：郭朝先，研究员，邮箱：guochaoxian@163.com。

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度由1.98%提升至2.64%；基础研究投入占全社会研发经费比重由4.8%增至6.65%（见图1、图2）。中国研发经费投入强度位列世界第13位，介于欧盟（2.2%）和经合组织国家（2.7%）平均水平之间（范思立，2023）。2023年，中国全年发明专利授权数为92.1万件，国内（不含港澳台）有效发明专利401.5万件，成为全球首个突破400万件的国家。近年来，中国创新能力大幅跃升，以2015年为基期，2022年中国创新指数为155.7，4个分领域指数——创新环境指数、创新投入指数、创新产出指数和创新成效指数分别为160.4、146.7、187.5和128.2（国家统计局，2023a）。据世界知识产权组织披露，中国成为全球创新版图中日益重要的一员，中国创新指数位居全球第11位，成为全球唯一进入前15位的发展中国家；中国创新指数排名已连续10年稳步提升，提升速度位居36个中高收入经济体之首（新华社，2023）。

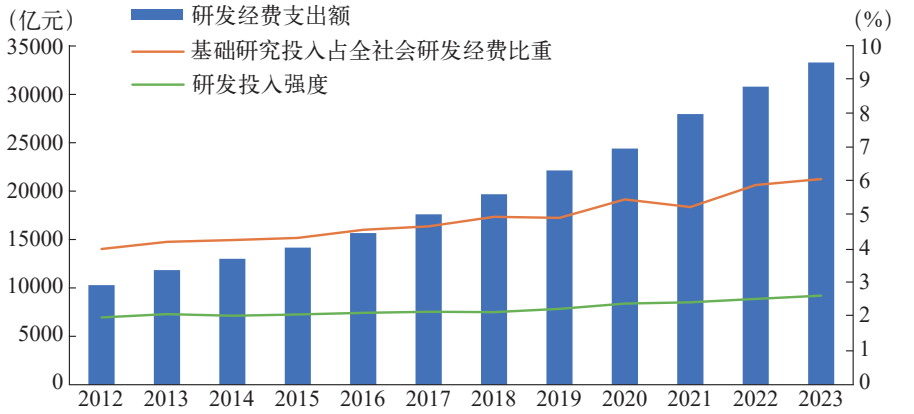

图1：2012~2023年中国研发投入情况

数据来源：据国家统计局数据整理而得。

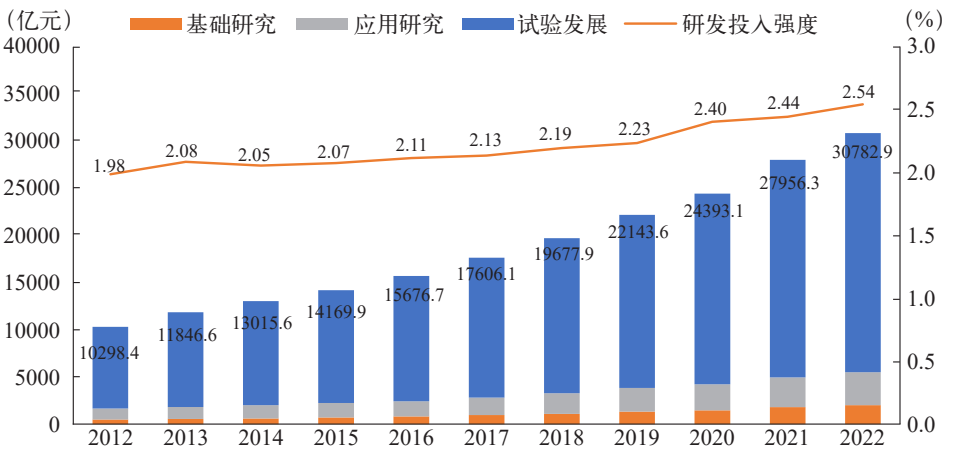

图2：2012~2022年我国创新投入规模及其结构与创新投入强度变化情况

数据来源：根据2012~2022年全国科技经费投入统计公报、中华人民共和国2023年国民经济和社会发展统计公报整理汇总，其中2023年缺少规模结构数据。

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（二）从“人口红利”到“人才红利”的转型实现质的跃迁

2012~2022年，研究生招生人数从58.97万人上升到124.25万人，R&D就业人数从324.7万人上升到635.4万人，10年内高素质人才资源培养和使用量翻番。2023年，全国劳动年龄人口平均受教育年限提升至11.05年，全国新增劳动力平均受教育年限提升至14年，接受高等教育人口达2.4亿人，人才资源总量、科技人力资源、研发人员总量均居全球首位，“人口红利”正在加快向“人才红利”转化（盛来运，2024）。数量庞大的高质量劳动力资源正源源不断地供给，为经济长期发展提供强大智力资源支持。

（三）基础设施不断完善，新型基础设施规模处于全球第一梯队

截至2023年底，全国铁路营业里程达到15.9万公里，其中高铁营业里程4.5万公里。5G、量子通信等通信基础设施、数据基础设施建设走在世界前列，人工智能、云计算等技术基础设施建设加快；工业互（智）联网、智慧交通网络等融合基础设施国际领先。2022年，中国算力总规模达到302EFlops（EFlops为每秒10^18次浮点运算单位），居世界第二，占全球份额约为33%，连续两年增速超过50%。全国性工业互联网络构建成型，北京、上海、武汉、重庆、广州五个国家顶级节点和南京、成都两个灾备节点全部上线。二级节点覆盖了全国各省区市，服务近24万家企业，包含45个国民经济大类和85%以上的工业大类。此外，已培育240多个有影响力的工业互联网平台和28个跨行业跨领域平台，重点平台连接设备超过8000万台，服务超过160万家工业企业。全国建成“5G+工业互联网”项目超过4000个，在建项目超过7000个，大力支持生产各环节、产品全流程、供应链上下游的数据互通、资源协同，加速企业数字化转型。

二、关键前沿技术研发获得新突破

近年来，中国深入实施创新驱动发展战略，加大对基础、应用研究和关键核心技术攻关的支持力度，关键核心技术攻关成果丰硕，第四代核电机组、燃气轮机、航空发动机等高端装备研制取得长足进展，在芯片、5G、深海、航天、交通、能源等重点领域也取得一系列突破性进展。

（一）芯片、5G、量子计算等实现重大技术突破

华为麒麟9000S处理器突破国外技术垄断，制程达到7nm工艺水平，并通过架构创新与提高晶体管密度使其性能接近国外5nm工艺产品。鸿蒙操作系统持续更新突破。累计建成5G基站337.7万个，千兆端口2302万个，5G定制化基站、5G轻量化技术实现商用部署，工业级5G芯片、模组、网关实现突破，累计发布3项国际标准和90项国家标准。“九章三号”量子计算原型机刷新光量子信息的技术水平和量子计算性能的世界记录，比目前全球最快的超级计算机“前沿”（Frontier）

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快一亿亿倍。“九章三号”1微秒可算出的最复杂样本，“前沿”要算约200亿年。

（二）航天工程技术跻身世界先进水平

2023年，神舟十六号、十七号载人飞船圆满发射并对接天宫空间站，标志着中国空间站乘组轮换和科学实验进入常态化阶段，载人航天环控生保技术已跻身世界先进水平、空间交会自主对接GNC（制导、导航与控制）技术进一步成熟。目前，已有10余类20余款耐辐射、高耐热、高抗寒的国产空间站芯片完成在轨飞行验证。可重复使用航天器在轨飞行276天后成功返回预定着陆场，完成可重复试验。长征五号运载火箭突破大直径舱箭连接分离技术、大尺寸整流罩分离技术、大推力直接入轨偏差精确控制技术，将中国近地轨道运载能力提升到22吨以上。

（三）极地、深海、远洋探索刷新极限

2023年1月，中国自主研制的“奋斗者号”载人潜水器完成南极科考，最大下潜深度达10909米，填补了中国在极地深潜领域的空白。2023年12月，中国自主设计建造的首艘超深水大洋科考钻探船“梦想”号顺利试航，其总吨位约33000吨，续航里程15000海里，建有全球面积最大、功能最全、流程最优的船载实验室，拥有全球规模最大、最先进的科考船综合信息化系统，具备全球海域无限航区作业能力和11000米钻探能力。

（四）海陆空立体化交通工程迈出新步伐

自主研制的中程窄体干线商用飞机国产大飞机C919顺利完成首飞，项目总体技术水平与研制装配线达到国际先进水平，全面提升中国民航业的全球影响力与竞争力。国产首艘大型邮轮“爱达·魔都号”交付使用，标志着中国已具备同时建造大型邮轮、大型液化天然气运输船、航空母舰的造船工业能力。时速600公里的高速磁悬浮试验样车完成系统联调联试，首条设计时速350公里的跨海高铁——福厦高铁正式开通运营。车用芯片、全固态电池、高级别自动驾驶技术取得一系列突破。

（五）多元化清洁能源工程项目取得重大进展

中国自主研制的全超导托卡马克核聚变实验装置（EAST）在多个实验中取得重要成果，突破100万安培等离子体大电流高约束模式运行控制、高功率加热系统注入耦合、先进偏滤器位形控制等多个关键技术难题。世界规模最大、技术难度最高的水电工程白鹤滩水电站建成运行，世界首例首批安装16台单机容量百万千瓦的水轮发电机组，引领水力发电进入单机百万千瓦新时代。首套300MW级先进压缩空气储能系统压缩机和膨胀机成功研制，推动中国先进压缩空气储能技术迈向新台阶。

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三、新兴高端产品生产迈上新台阶

中国是产业体系最完整的全球第一工业大国，拥有41个工业大类、207个工业中类、666个工业小类，是全世界唯一拥有联合国产业分类中全部工业门类的国家，制造业规模已经连续13年居世界第一，占全球比重超过30%（陈彬，2024）。产业体系配套完整的供给优势和庞大的生产能力，为新兴高端产品的生产提供了不竭的动力。

（一）新产品生产快速增长

2015~2022年，全国新产品销售收入年均增长11.7%。2022年，规模以上工业企业实现新产品销售收入达到32.8万亿元，占总营业收入的24.6%，比2015年提高了11.0个百分点。其中，达到国内新产品水平的销售收入为9.9万亿元，达到国际新产品水平的销售收入为3.5万亿元，分别比2016年增长77.8%和60.9%（国家统计局，2023b）。

（二）智能产品生产迅猛发展

经济社会数字化智能化快速发展与人民消费需求升级相结合，使得近年来智能产品和智能设备制造相关行业高速增长，比如，2023年智能车载设备、智能无人飞行器、3D打印设备分别增长了60.0%、20.5%和36.2%。而高技术智能化仪器仪表生产应用则加快助力各行业数字化智能化发展，其中运输设备及生产用计数仪表制造、地质勘探和地震专用仪器制造增加值分别增长了12.9%和27.6%（汤魏巍，2024）。

智能产品生产成长表现最“亮眼”的是工业机器人和服务机器人。当前，中国是全球最大的机器人市场。汽车、电子、物流、化工、机械制造等领域已广泛使用机器人，特别是在新能源汽车、锂电池、光伏等新兴产业领域工业机器人应用已“蔚然成风”；餐饮、医疗、健康、养老、家居、安防等领域服务机器人得到越来越广泛的应用，而特种机器人在农林生产、应急救援、环境保护、科学考察等方面发挥越来越重要的作用。自2016年首次超越日本成为全球机器人存量第一大国之后，中国工业机器人销量呈现高速增长态势，2022年中国机器人全行业营业收入超1700亿元。2022年中国工业机器人保有量已达135.7万台，占据全球市场份额的52.5%，相较于2012年仅14%的份额占比实现跨越式增长，十年间复合年均增长率高达28.8%。2023年，中国工业机器人产量42.95万套，连续两年突破40万套大关；服务机器人产量达796.3万台，同比增长23.3%。2022年中国工业机器人进出口总额为26.1亿美元；2023年1~10月，中国机器人产品进出口总额已经达到26.6亿美元，同比增长23%。[①]

[①] 数据来源说明：1.销量和保有量：国际机器人联合会（IFR）《2023年世界机器人报告》；2.产量：工业机器人产量是统计局公布的《1-12月规模以上工业生产主要数据》，服务机器人产量当前只能查到增长率，根据2022年值计算所得。

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四、产业结构高级化跨入新阶段

（一）中国经济进入服务业主导发展阶段

经济发展带来产业升级，2012年服务业（第三产业）增加值占GDP比重首次超过第二产业，标志着中国三次产业结构从“二三一”向“三二一”的历史性转变。此后服务业占比持续上升，2015年，服务业占GDP比重达到50.8%，首次超过50%；2023年，中国服务业增加值占国民经济比重达到54.6%，其对GDP增长贡献率为60.2%。“三二一”产业格局更加稳固，中国经济已成为服务业主导的现代经济（见图3）。

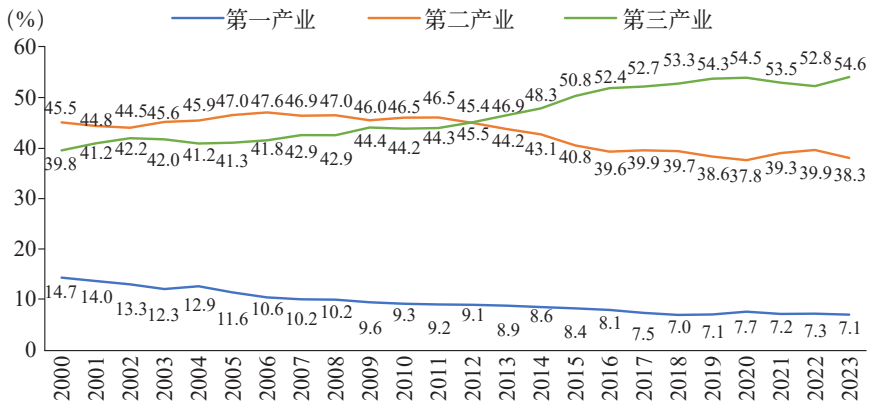

图3：中国三次产业结构变化图

资料来源：根据《中国统计年鉴（2023）》（中国统计出版社2023年版）和《中华人民共和国2023年国民经济和社会发展统计公报》整理。

（二）服务业内部结构在调整中持续优化

生产服务业占比超过生活服务业，技术密集型、知识密集型服务业规模大幅度增加。2022年中国生产性服务业增加值为364503亿元，占服务业比重达到57.3%（见图4）。2023年，在生产性服务业中，金融业、信息传输、软件和信息技术服务业、租赁和商务服务业的占比分别为27.8%、13.8%、11.3%，现代服务业及知识密集型服务业的支撑作用逐渐凸显。

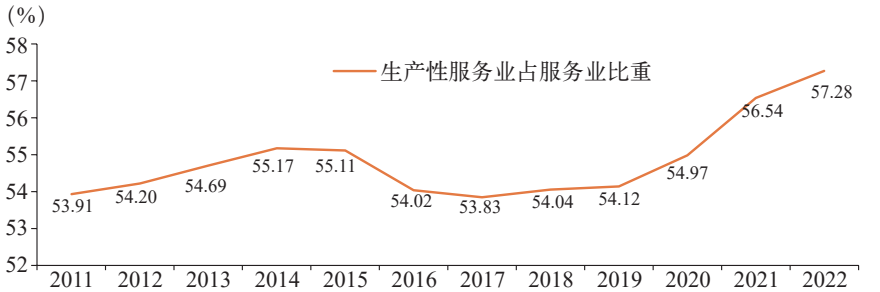

图4：2011~2022年生产性服务业占服务业比重变化情况

数据来源：作者计算。

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（三）高新技术产业成为拉动中国制造业发展的关键动能

2018~2023年，中国高技术产业投资增速一直保持在10%以上，远高于全国固定资产投资增长率，持续推动高技术产业转型升级。2023年，高技术产业投资增速为10.3%，快于全国固定资产投资平均增速7.3个百分点；其中，高技术制造业和高技术服务业投资同比增长9.9%和11.4%，分别高于全部固定资产投资平均增速6.9个和8.4个百分点。高技术制造业中，电子及通信设备制造业，计算机及办公设备制造业，航空、航天器及设备制造业投资分别增长11.1%、14.5%和18.4%；高技术服务业中，电子商务服务业、科技成果转化服务业投资分别增长29.2%、31.8%（翟善清，2024）。

（四）产业融合成为一个重要趋势

其中一二三产业融合、数字经济与实体经济融合成为“新常态”。一二三产业融合已进入现代服务业和先进制造业、现代农业融合发展新阶段。根据《全球服务型制造发展指数报告》，2021年中国服务型制造指数为113.71，位列全球榜单第四名，连续5年保持稳定增长。如表1所示，截止到2023年，工信部先后公布了五批服务型制造示范名单，包含372个示范企业、225个示范平台（包括共享制造类示范平台）、157个示范项目，制造业正在实现从“生产型制造”向“服务型制造”转变。2022年，农业及相关产业的增加值中，第三产业增加值占比为25.7%，其中，农林牧渔业及相关产品流通服务占比14.1%。现代服务业已成为小农户和现代农业相互衔接的有效路径，现代农业的发展壮大离不开现代服务业的支撑保障。

表1：第一批至第五批服务型制造示范企业、示范平台、示范项目数量

	第一批	第二批	第三批	第四批	第五批
示范企业	30	33	88	111	110
示范平台	30	31	56	57	51
示范项目	60	50	25	22	/

数据来源：作者根据工信部官网公布名单整理。

（五）数实融合扎实推进

数实融合推进突出表现为以新产业、新业态、新模式为代表的“三新”经济持续蓬勃发展。2015~2022年，中国“三新”经济增加值年均增速为10.9%，比同期GDP增速高2.5个百分点；2022年，中国“三新”经济增加值达到21.01万亿元，占GDP比重为17.36%，比2015年提高2.6个百分点（见图5）；其中一二三次产业内容的“三新”经济占比分别为4.0%、44.2%、51.8%。以现代农林牧渔业、先进制造业、互联网与现代信息技术服务、现代技术服务与创新创业服务、现代生产性服务活动等行业为代表的“三新”经济正成为中国经济高质量发展与产业转型升级的核心贡献力量。

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值得一提的是，2023年文旅、生态等多元新兴业态“火爆出圈”。2023年，文化新业态特征较为明显的16个行业小类实现营业收入52395亿元，比上年增长15.3%，文化新业态行业对规模以上文化企业营收增长贡献率达70.9%。“淄博烧烤”“冰雪运动”“冰雪旅游”等消费热点火爆出圈，文化经济、体育经济、生态经济等新兴业态共同发力，国内大循环主体增长潜力得到充分释放。

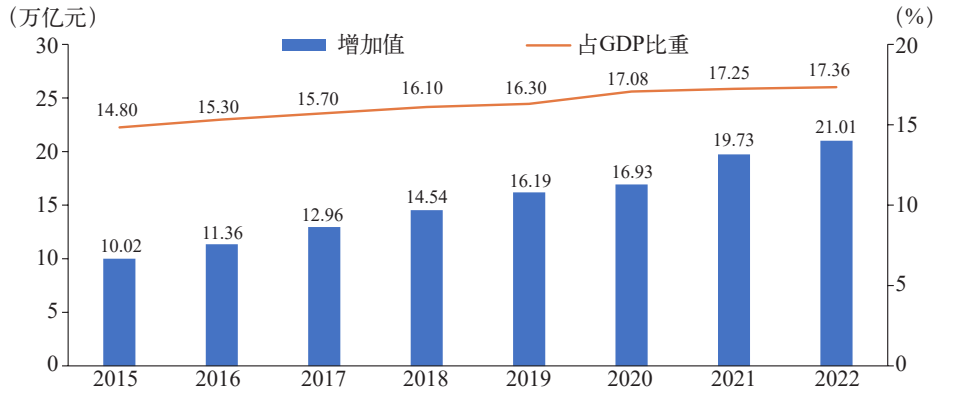

图5：2015~2022年三新经济增加值及占GDP比重

数据来源：国家统计局。

五、数字经济发展塑造新动能

（一）数字经济规模和渗透率快速增长

据中国信息通信研究院测算，2022年中国数字经济规模达到50.2万亿元，同比增长10.3%，占GDP比重达到41.5%，占比和第二产业相当，规模和比重位居世界前列（见图6）。工业数字经济渗透率为24%，工业企业关键工序数控化率、数字化研发设计工具普及率大幅度提升。服务业数字经济渗透率为44.7%。农业数字化加快向全产业链延伸，农业数字经济渗透率达10.5%。

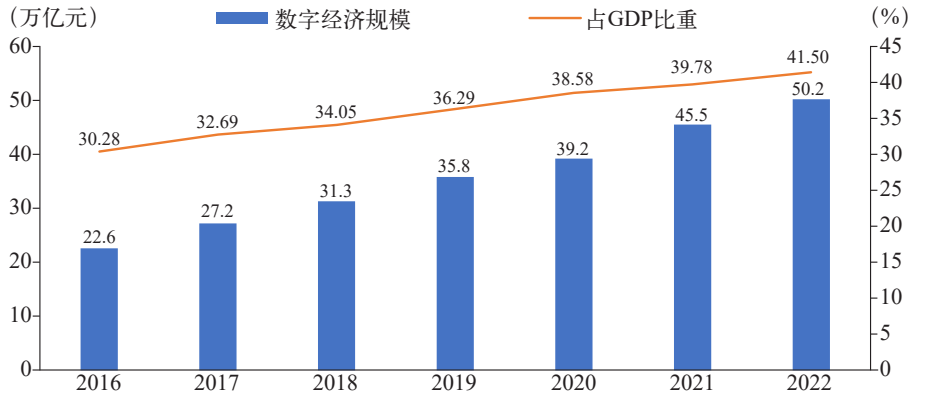

图6：中国数字经济发展情况

资料来源：根据中国信息通信研究院历年公布的报告整理。

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（二）数据要素赋能各行各业

当前，新一轮科技革命和产业变革深入发展，数据作为新的要素进入生产函数，数据要素在产业发展中的地位日益重要，是新质生产力的重要要素支撑。2022年，中国数据生产量占全球数据总生产量的10.5%，居全球第二位，数据存储量全球占比达到14.4%，大数据产业规模达到1.57万亿元。包含数据采集、标注、分析、存储等数据资源化进程不断深化，数据标注产业围绕北京、长三角、成渝地区向外扩散，已经形成三大产业群，并对周围地区产生技术溢出效应。依据《“数据要素×”三年行动计划（2024~2026年）》，中国将率先在工业制造、现代农业、商贸流通、交通运输等12个行业推广应用“数据要素×”，将充分发挥中国海量数据资源、丰富应用场景、超大规模市场等优势，推动数据要素与劳动力、资本等要素协同，以数据流引领技术流、人才流、资金流、物资流，突破传统资源要素约束，提高全要素生产率；促进数据多场景应用、多主体复用，培育基于数据要素的新产品和新服务，开辟经济增长新空间；通过加快多元数据的融合，扩大数据规模以及丰富数据类型，促进生产工具创新升级，催生新产业新模式新业态，培育经济发展新动能（国家数据局等，2024）。

（三）“人工智能+”助推产业转型升级

2024年《政府工作报告》中首次提出“人工智能+”的概念，这意味着人工智能将更广泛地应用于各个领域，推进科技创新和产业创新深度融合，创造出新的产品、服务和商业模式，推动传统行业的转型升级和社会经济结构的变革，加快塑造高质量发展新动能新优势。数据显示，中国人工智能核心产业规模达到5000亿元，企业数量超过4400家，已建设近万个数字化车间和智能工厂。据工信部赛迪研究院调查统计，2023年中国生成式人工智能的企业采用率已达15%，在制造业、零售业、电信行业和医疗健康四大行业中，生成式人工智能技术的采用率均取得较快增长，市场规模约为14.4万亿元。专家预测，2035年生成式人工智能有望为全球贡献近90万亿元的经济价值，其中中国将突破30万亿元（杜壮，2024）。

（四）工业领域的智能制造持续推进

随着制造业智能化持续推进，近年来自动化相关行业发展较快，2023年电子元器件与机电组件设备制造、集成电路制造增加值较上年分别增长29.8%和10.3%。智能制造应用规模和水平大幅度提升，目前40%以上的制造企业进入数字化、网络化制造阶段，制造机器人密度跃居全球第5位，2022年上半年总销量达到13.1万台，产业规模达到3万亿元，市场满足率超过50%。截至2023年底，中国建成了62家“灯塔工厂”，占全球总数的40%，培育了421家国家级智能制造示范工厂、万余家省级数字化车间和智能工厂（王绍绍，2024）。

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（五）服务业领域的电子商务、网上销售等数字经济新业态新模式如火如荼

近年来，电子商务规模持续扩大，据统计，2023年中国电子商务交易额达到46.83万亿元，比上年增长9.4%（国家统计局，2024）。商务部数据显示，2023年网上零售额为15.43万亿元，比上年增长11.0%，中国已连续11年成为全球第一大网络零售市场。[②]2023年，实物商品网上零售占社会消费品零售总额比重增至27.6%，创历史新高。数实融合、线上线下融合持续推进，以线上平台、电子商务为代表的新业态新模式不断发展，已成为推进产业转型升级、增强经济活力的重要力量。2023年，在线旅游、在线文娱和在线餐饮销售额分别增长237.5%、102.2%和29.1%，三者合计对网络零售销售额增长贡献率为23.5%，拉动网络零售销售额增长2.6个百分点（商务部新闻办公室，2024）。2023年，全国快递业务量超1300亿件，实现“月均百亿”的跨越，比上年增长19.5%。

六、绿色经济发展创造新奇迹

中国共产党第二十次全国代表大会报告提出，“中国式现代化是人与自然和谐共生的现代化”。生态效率和经济效率并重的绿色发展是中国式现代化的一大亮点和鲜明特色。2020年，中国政府作出“二氧化碳排放力争于2030年前达到峰值、努力争取2060年前实现碳中和”的庄严承诺，体现出坚定不移走绿色低碳高质量发展道路的决心，将完成全球最高的碳排放强度降幅，有力推进全球绿色发展进程。近年来，中国牢固树立“绿水青山就是金山银山”的发展理念，协同推进降碳、减污、扩绿、增长，推进产业绿色低碳转型，提升了增长的“含金量”和发展的“含绿量”。

（一）以技术创新引领产业绿色化转型

截至2021年底，中国新能源产业有效发明专利6万件，节能环保产业有效发明专利4.9万件，分别是2017年底的1.7倍和1.6倍。2011~2020年，中国环境技术发明专利申请总量接近全球60%，是全球布局环境技术创新最积极的国家（中华人民共和国国务院新闻办公室，2023）。近年来，能源资源利用效率持续提升，绿色技术装备制造体系日臻完善，新能源、污染治理、环境监测等多个领域的技术达到国际先进水平，技术引领产业绿色化发展越来越快。

（二）新能源产品生产全球领先

2023年，新能源产品引领绿色发展，日益成为经济新增长点。电动载人汽车、锂动力电池、太阳能电池等“新三样”相关产品产量较快增长。在能源绿色转型引领下，风力发电机组、水轮发电

[②] 电子商务交易额是指通过电子商务交易平台（包括企业自建平台和第三方平台）实现的商品和服务交易额，包括对单位和对个人交易额；网上零售额是指通过公共网络交易平台（主要从事实物商品交易的网上平台，包括自建网站和第三方平台）实现的商品和服务零售额。电子商务交易额和网上零售额增速均按可比口径计算。

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机组、充电桩等绿色能源相关产品生产保持高速，2023年产量分别增长28.7%、35.3%和36.9%；绿色材料供给增加，太阳能工业用超白玻璃、碳纤维及其复合材料、生物基化学纤维等绿色材料产品产量分别增长58.6%、57.1%、50.7%（汤魏巍，2024）。2023年，多晶硅、硅片、电池、组件产量全球占比均超过70%（中国青年网，2024）。

（三）可再生能源产业发展迅速

根据国家能源局的数据，2022年，全年可再生能源新增装机量达1.52亿千瓦，占全国新增发电装机的76.2%，已成为中国电力新增装机的主体。其中，风力发电、太阳能发电、生物质发电、常规水力发电、抽水蓄能新增装机容量分别为3763万千瓦、8741万千瓦、334万千瓦、1507万千瓦和880万千瓦。截至2022年底，可再生能源装机容量突破12亿千瓦，达到12.13亿千瓦，占全国发电总装机的47.3%。其中，风力发电、太阳能发电、生物质发电、常规水力发电、抽水蓄能装机容量分别为3.65亿千瓦、3.93亿千瓦、0.41亿千瓦、3.68亿千瓦和0.45亿千瓦（国家发展和改革委员会环资司，2023）。2023年，中国可再生能源装机进一步增至14.5亿千瓦，占全国发电总装机比重超过五成。在全球范围内，中国的风能、太阳能、水能、生物质发电装机容量均居世界第一，已成为风电光伏设备和动力电池主要供应国，并推动了全球可再生能源部署成本大幅下降。2023年，“综合智慧零碳电厂”在全国多地建成，这种电厂无厂房、不烧煤，优先消纳“风、光、水”等产生的“绿电”，把来自工厂、商场甚至居民家的零散电力负荷聚合起来，通过智慧系统调控，对外等效形成一个与电网友好互动的“智慧电厂”，实现真正的零碳（白雪，2024）。

（四）绿色现代化产业体系初步建立

传统产业加快调整优化，对资源消耗量高、污染排放量大的产业实行产能置换，利用绿色技术改造传统产业。大力发展绿色新兴产业，培育壮大绿色发展的新动能，深入推动人工智能、大数据等新兴技术与绿色产业深度融合，以新质生产力带动绿色产业高质量发展。打造绿色工厂、绿色产业链以及绿色园区，逐步构建起从基础原材料到终端消费品的全链条绿色产品供给体系。

七、产业国际化迈出新步伐

近年来，中国坚定不移推进高水平对外开放，加快打造更高水平开放型经济新体制，高质量共建“一带一路”，以自身发展为世界创造了更多机遇。据统计，2022年，中国货物进出口总额6.31万亿美元，比2000年的13倍还多。尤其是自“一带一路”倡议提出以来，中国扎实推进“一带一路”经贸合作，2023年，中国与共建“一带一路”国家进出口贸易占比提升至46.6%。对外开放新平台

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正抓紧建设，以自有贸易试验区为平台的进出口贸易占比提升至18.4%（盛来运，2024）。

（一）高新技术产品出口成为中国出口主导产品

中国已实现从“两头在外、大进大出”的加工贸易方式和劳动密集型产品出口为主，到一般贸易方式和机电产品和高技术产品出口为主的历史性转变，产品国际竞争力显著增强。如表2所示，2023年，中国机电产品出口额为13.92万亿元，占出口总额的58.6%；同期，劳动密集型产品出口4.11万亿元，仅占出口总额的17.3%。其中，新能源汽车、锂电池、太阳能电池被称为中国外贸“新三样”，海关总署统计数据显示，2023年“新三样”产品合计出口1.06万亿元，首次突破万亿大关，增长了29.9%，国际市场份额占比大幅提高。

表2：2012~2023年我国产品出口贸易情况

	货物出口总额（亿元）	其中：一般贸易（亿元）	占比	加工贸易（亿元）	占比	机电产品（亿元）	占比	高新技术产品（亿元）	占比
2012	129337	62368	0.48	54464	0.42	74450	0.58	37951	0.29
2013	136845	67351	0.49	53292	0.39	78356	0.57	40894	0.30
2014	143912	73944	0.51	54320	0.38	80527	0.56	40570	0.28
2015	141255	75456	0.53	49553	0.35	81421	0.58	40737	0.29
2016	138455	74601	0.54	47237	0.34	79820	0.58	39876	0.29
2017	153321	83325	0.54	51381	0.34	89465	0.58	45150	0.29
2018	164177	92405	0.56	52676	0.32	96457	0.59	49374	0.30
2019	172342	99546	0.58	50729	0.29	100631	0.58	50427	0.29
2020	179326	106460	0.59	48589	0.27	106608	0.59	53692	0.30
2021	217348	132445	0.61	53378	0.25	128286	0.59	63266	0.29
2022	239654	152468	0.64	53952	0.23	136973	0.57	63391	0.26
2023	237726	153530	0.65	49062	0.21	139196	0.59	59279	0.25

数据来源：根据2012～2022历年国民经济和社会发展统计公报整理汇总。

（二）中国对外直接投资已位居世界前列

2022年，中国对外直接投资额为1631.2亿美元，为全球第二位，连续11年居全球前三，连续7年占全球份额超一成（见图7）。2022年末，中国对外直接投资存量达2.75万亿美元，连续六年排全球前三（中华人民共和国商务部等，2023）。2013~2021年，中国累计对“一带一路”沿线国家直接投资达到1613亿美元，年均增长5.4%，“一带一路”沿线国家已成为中国企业对外投资的首选地。行业属性方面，中国对外直接投资从20年前的以采矿、制造业等传统行业为主，初步完成了向第三产业为主的转变，信息产业、科研及技术服务两大产业保持着较高的增速，十年复合增长率分

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别达32%、20%。投资结构方面，2022年，中国对外直接投资涉及18个行业大类，其中流向采矿、制造、交通运输、金融、批发零售、租赁和商务服务等领域投资均超过百亿美元。贡献税收方面，2020年，境外中资企业向投资所在国家和地区缴纳税金合计达445亿美元。吸纳就业方面，2020年，境外中资企业雇用外方员工218.8万人（汪文正，2021）。可见，中国对外合作正不断深化，中国企业为推动中国与世界各国实现互利共赢、共同发展繁荣贡献了强大的中国力量。

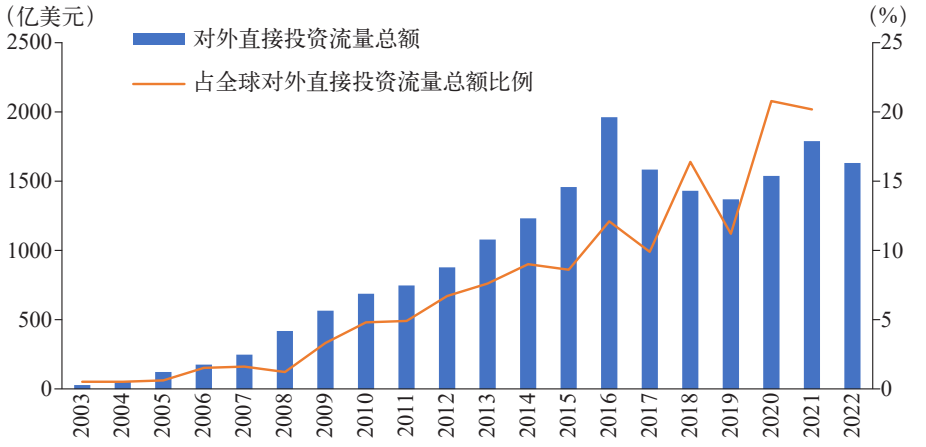

图7：2003~2022年中国对外直接投资情况

数据来源：国家统计局。

（三）产业国际化逐渐实现从“走出去”到“融进去”的跨越式发展

中国企业国际化已经历产品国际化、资本国际化和能力国际化三个阶段，其中，能力国际化是指海外投资企业具有海外市场本土化运营的能力。经过多年的国际化发展，中国企业国际化发展从简单的产品出口，逐渐发展到如今的产品、资本、经营模式、营销战略、海外技术等综合能力的国际化。当前，中国企业的国际化方式呈现出“从产品输出到模式输出”“从单枪匹马到产业抱团”“从粗放收购到精细整合”三大特点，这三大转变反映出一个共性趋势——中国企业正在深度介入甚至重塑海外市场的价值链环节，全面打造海外市场本土化运营能力。以《财富》中国500强企业为例，2021年已有约90%的企业拥有不同形式的国际化业务，其中近一半企业仍然将扩大海外国际化业务作为企业未来重要战略之一，但扩大国际化业务的方式已不仅仅集中于海外投资并购（仅10%的企业将其作为重点发展方向），而是兼顾海外本土化运营，如海外营销能力建设（29%的企业将其作为重点发展方向）、海外供应链（24%的企业将其作为重点发展方向）与海外技术（11%的企业将其作为重点发展方向）等（领英中国、波士顿咨询公司，2022）。

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New Milestone Achievements in China's Industrial Transformation and Upgrading

Research Group of the Institute of Industrial Economics, Chinese Academy of Social Sciences (IIE-CASS), Beijing, China*

Abstract: *In recent years, China has steadily advanced high-quality economic development, moving from "made in China" to "invented in China", and scoring new milestones in industrial transformation and upgrading. In terms of resource endowment structure, China has succeeded in bolstering innovation investment and capabilities, as well as converting its demographic dividend into a talent dividend, propelling it into the ranks of leading nations in terms of new infrastructure capacity. China has made groundbreaking progress in 5G, deep ocean, aerospace, transportation, energy, and other critical sectors. China has achieved a rapid expansion in the manufacturing of emerging high-end products, becoming the world's largest robotics market. In terms of industrial structural transformation, China's economy has moved into a service-based development stage, with producer services accounting for a rising share. Technology-intensive and knowledge-intensive services have thrived, high-tech sectors have served as vital economic growth drivers, and integration of the primary, secondary, and tertiary industries, as well as the digital and real economies, has emerged as a prominent trend. The digital economy is growing fast in terms of scale and penetration. "Digital factor×" and "AI+" applications are accelerating industrial upgrading, spawning new business models like smart manufacturing, e-commerce, and online sales. In terms of the green economy, China has initially created a green modern industrial system, transforming itself into a global powerhouse of new energy goods, with renewables accounting for the vast majority of its newly installed generation capacity. In terms of industrial internationalization, high-tech products have made up the bulk of China's exports, China has emerged as a key source of outward direct investment, and the focus of its industrial internationalization has shifted from "going global" to "integrating locally".*

Keywords: *Industrial transformation and upgrading, milestones, critical frontier technologies, digital economy, green economy*

JEL Classification Code: O10

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In 2010, China surpassed Japan in terms of GDP to become the world's second-largest economy. In the same year, China overtook the United States in terms of manufacturing value added, becoming

* CONTACT: Guo Chaoxian, email: guochaoxian@163.com.

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Written by: Prof. Shi Dan (Director and Research Fellow of the IIE-CASS), Prof. Zhang Qizi (Deputy Director and Research Fellow of the IIE-CASS), and Prof. Guo Chaoxian (Director and Research Fellow of the Research Office of Industrial Organization, IIE-CASS).

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the world's largest manufacturing nation. Since then, China has maintained its status as the world's second-largest economy and largest manufacturing hub. In recent years, China has been steadily advancing high-quality economic development, shifting from "made in China" to "invented in China", and significantly accelerating industrial transformation and upgrading with milestone achievements. "Invented in China" has grown in strength, as evidenced by the transformation of China's factor endowment structure, new breakthroughs in critical frontier technologies, new levels of emerging high-end products, new stages of industrial structure sophistication, new dynamism from the digital economy, new miracles created in the green economy, and new strides in industrial internationalization.

1. Step Change in China's Factor Endowment Structure

1.1 Ramping up Innovation Spending and Capacity

Between 2012 and 2023, China's total R&D spending climbed from 1.03 trillion yuan to 3.33 trillion yuan, which resulted in a rise in R&D spending intensity from 1.98% to 2.64%. Basic research expenditures as a percentage of total R&D spending also increased, from 4.8% to 6.65% (see Figure 1 and Figure 2). China is ranked 13th in the world in terms of R&D spending intensity, higher than the European Union (2.2%) but lower than the average of OECD countries (2.7%) (Fan, 2023). In 2023, China licensed 921,000 invention patents for the entire year, with 4.015 million valid domestic invention patents, making it the first country in the world with over 4 million patents. China's ability to innovate has grown dramatically in recent years. With 2015 as the base period, China's innovation index reached 155.7 in 2022, with the four innovation sub-indices for innovation environment, input, output and effectiveness standing at 160.4, 146.7, 187.5, and 128.2 respectively (National Bureau of Statistics, 2023a). According to the World Intellectual Property Organization (WIPO), China has risen in importance in the global innovation scene, placing 11th in the world on the innovation index. This makes China the only developing country to rank in the top 15 on the list. China's innovation index ranking has risen for ten consecutive years at the fastest pace among the 36 medium-high income economies (Xinhua News Agency, 2023).

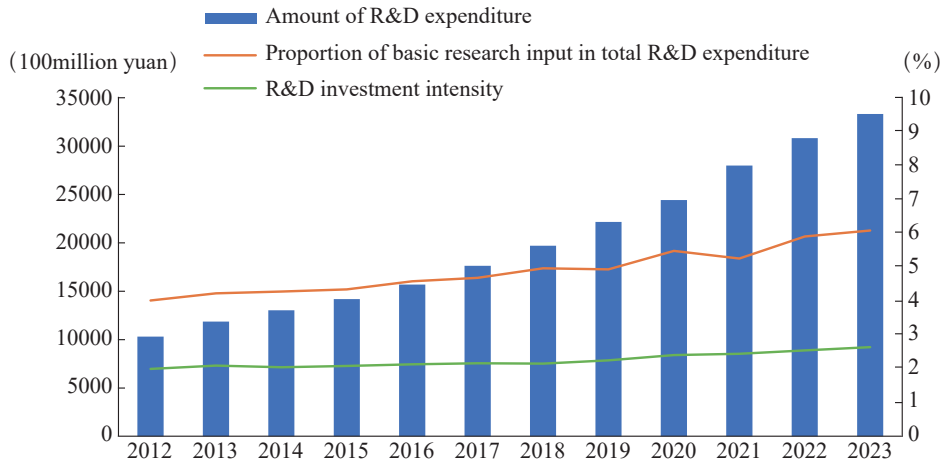

Figure 1: R&D Investment in China from 2012 to 2023

Source: Compiled from National Bureau of Statistics data.

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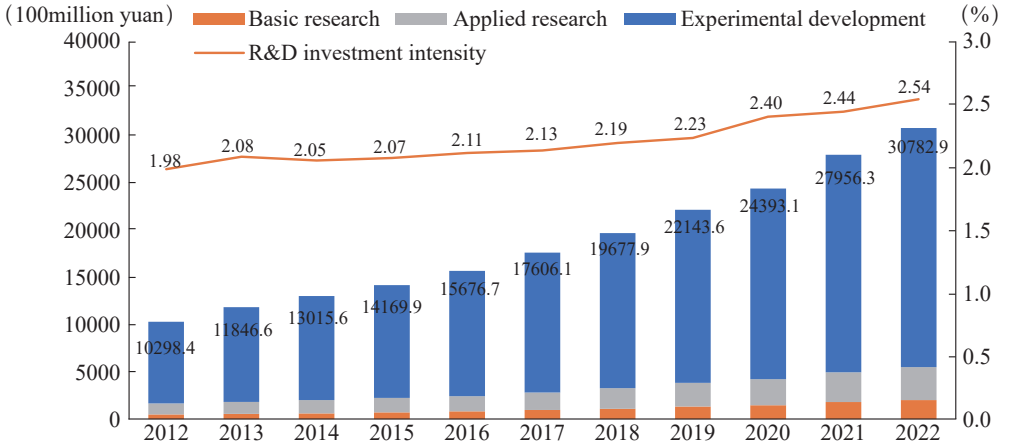

Figure 2: Scale and Structure of Innovation Investments and Changes in Investment Intensity in China from 2012 to 2022

Source: Compiled based on the *Statistical Communiqué of the People's Republic of China on Science and Technology* (2012-2022) and the *Statistical Communiqué of the People's Republic of China on the 2023 National Economic and Social Development*. The data on scale structure for 2023 is missing.

1.2 Qualitative Transition from Demographic Dividend to Talent Dividend

From 2012 to 2022, China's postgraduate student enrollment grew from 589,702 to 1,242,500 persons, while the number of R&D personnel surged from 3.247 million to 6.354 million. Over the past decade, China's cultivation and employment of highly qualified professionals has doubled. In 2023, the average length of education for China's working-age population climbed to 11.05 years, while the average length of education for China's new workforce increased to 14 years, and the number of college graduates reached 240 million. With these accomplishments, China has the world's largest pool of human resources, technologists, and R&D personnel, converting its demographic dividend into a talent dividend (Sheng, 2024). The unremitting supply of human capital provides strong intellectual support for long-term economic development.

1.3 Developing New Infrastructure at the Forefront of the Global Infrastructure Renewal

By the end of 2023, China had 159,000 km of railway in operation, including 45,000 km of high-speed rail. China is the world leader in communication and digital infrastructures, including 5G and quantum communication, and is doubling down on artificial intelligence (AI), cloud computing, and other technological infrastructures. It also leads in industrial Internet, smart transportation networks, and other integrated infrastructures. In 2022, China's total computing power reached 302 eflops (1 eflop is equal to 1 quintillion (10^18) floating-point operations per second), ranking second in the world with a 33% global share, after annual expanding by more than 50% in two consecutive years. China's five national top nodes, including Beijing, Shanghai, Wuhan, Chongqing, and Guangzhou, as well as two catastrophe backup nodes in Nanjing and Chengdu, have all gone operational, leading to a nationwide industrial Internet system. Secondary nodes support over 240,000 firms across 45 national economic sectors, including more than 85% of industrial categories across all provinces, autonomous regions, and municipalities. Furthermore, China has seen the emergence of over 240 influential industrial Internet platforms and 28 cross-sector platforms, connecting more than 80 million devices from 1.6 million industrial enterprises. Across the country, over 4,000 "5G plus industrial Internet" projects have been completed, with over 7,000 more under construction. They work together to facilitate data sharing and

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resource coordination between diverse manufacturing processes, as well as upstream and downstream supply chains, accelerating corporate digital transition.

2. New R&D Breakthroughs for Critical Frontier Technologies

In recent years, China has adopted an innovation-driven development strategy, focusing on basic and applied research, as well as the development of essential core technologies. As a result of these efforts, China has made great strides in the development of high-end equipment such as fourth-generation nuclear power plants, gas turbines, and aircraft engines, as well as key sectors such as chips, 5G, deep ocean, aerospace, transportation, and energy.

2.1 Major Technological Advancements in Chips, 5G, and Quantum Computing

Breaking free from foreign technology monopoly, Huawei has developed the Kirin 9000s processor on the 7 nm node, improving performance to match 5 nm chips through architectural innovation and higher transistor density. Each iteration of the Harmony operation system has brought fresh improvements. China has built 3.377 million 5G base stations and 23.02 million kilomega ports, as well as commercially deployed customized 5G base stations and 5G lightweight technologies. Breakthroughs in industrial-grade 5G processors, modules, and gateways have resulted in three international and 90 national standards. The Jiuzhang III photonic quantum prototype computer has made world records in photonic quantum information technology and quantum computing performance. It can compute the most complex Gaussian boson sampling in one microsecond, a task that would take over 20 billion years for the world's current fastest supercomputer "Frontier" to complete.

2.2 Leading the World for Aerospace Technology

In 2023, China's Shenzhou 16 and 17 manned spacecraft were successfully launched and docked with the Tiangong space station. This feat marks China's ability to carry out crewed missions for in-orbit rotations and scientific experiments regularly. China has reached internationally advanced levels for environmental control and life support system (ECLSS), and improved the guidance, navigation and control (GNC) technology for space rendezvous and docking. China has completed in-orbit tests of over 20 models of radiation-resistant space station processors for their performance at extreme temperatures. After 276 days of in-orbit flight, China's reusable spacecraft returned to the designated landing site, completing the test flight. The Long March 5 carrier rocket marks China's breakthroughs in large-diameter module-rocket connection and separation technology, large payload fairing separation technology, and precise deviation control technology for high-thrust direct injection orbit. It has raised China's payload capacity above 22 tons for low-Earth orbit.

2.3 Setting New Records for Polar, Deep Ocean, and Offshore Explorations

In January 2023, China's independently developed deep-sea manned submersible Fendouzhe (Striver) undertook a scientific voyage near Antarctica, plunging to a maximum depth of 10,909 meters below the sea surface. This is China's first submersible dive operation in the deep oceans near the polar region. Mengxiang (Dream), a 33,000-ton vessel capable of traveling 15,000 nautical miles, concluded its first trial voyage in December 2023. It is China's first independently designed and constructed ultra-deep-water research and ocean drilling vessel. It has the world's largest and most comprehensive onboard laboratory and most advanced information system, and it can operate in globally unrestricted maritime zones and drill depths of up to 11,000 meters.

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2.4 Making Advances in Maritime, Land, and Air Transportation

The C919, China's first midrange narrow-body trunk-line commercial passenger aircraft, successfully completed its inaugural flight. The aircraft, with its superior technological performance and manufacturing lines, has boosted China's global influence and competitiveness in the civil aviation industry. The delivery of China's first large cruise ship, "Adora Magic City", demonstrates China's ability to manufacture large cruise ships, huge LNG carriers, and aircraft carriers at the same time. In addition, China's 600 km/h high-speed magnetic levitation test vehicle completed a successful test run, and the country's first 350 km/h cross-sea high-speed railway between Fuzhou and Xiamen began service. Advances have been made in automotive processors, all-solid-state batteries, and advanced autonomous driving systems.

2.5 Making Progress in A Diverse Range of Clean Energy Projects

China's independently developed Experimental Advanced Superconducting Tokamak (EAST) has achieved notable outcomes in a variety of experiments, including large-current and high-confinement mode operation control for plasma currents exceeding 1 million amperes, injection coupling via a high-power heating system, and advanced divertor configuration. The Baihetan Hydropower Station, the world's largest and most advanced hydropower project, has begun operations. It has 16 hydropower turbines, each with a capacity of 1 million kw, which is the world's largest single-unit capacity. The successful creation of China's first 300MW compressor and expander represents a new era in compressed air energy storage (CAES) technology.

3. New Level in the Manufacturing of Emerging High-End Products

China is the world's largest industrial powerhouse, with the most complete industrial system. It is the only country with all of the United Nations industrial classification system's 41 industrial sectors, 207 categories, and 666 product sub-categories, ranking first in terms of industrial output capacity for 13 years in a row and accounting for more than 30% of the world's total (Chen, 2024). China's complete industrial system and massive manufacturing capacity provide an inexhaustible catalyst for the development of emerging high-end products.

3.1 New Product Manufacturing Has Expanded Rapidly

Between 2015 and 2022, China's new product sales revenue climbed by 11.7% on an annualized basis. In 2022, China's large industrial enterprises reported a new product sales revenue of 32.8 trillion yuan, accounting for 24.6% of their total business revenue, up 11.0 percentage points from 2015. Domestic new product sales revenue was 9.9 trillion yuan, while the revenue of sales of international-level new products reached 3.5 trillion yuan, representing a 77.8% and 60.9% increase over 2016, respectively (NBS, 2023b).

3.2 Smart Products Have Mushroomed

Digitalization and intelligence, together with rising consumer demand, have resulted in significant growth in the manufacturing of smart products and devices. In 2023, China's sales of smart onboard devices, drones, and 3D printers grew by 60.0%, 20.5%, and 36.2%, respectively. Smart instruments and apparatuses have accelerated digitization and intelligence in a variety of industries. The value added in the manufacturing of counter instruments for transportation equipment and industrial processes, as well as dedicated instruments for geological survey and seismic analysis, increased by 12.9% and 27.6%, respectively (Tang, 2024).

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Among smart products, industrial and service robots stand out. As the world's largest robotics market, China has extensively deployed industrial robots in a wide range of industries, including autos, electronics, logistics, chemical engineering, and mechanical manufacturing. Industrial robots are most commonly used in emerging sectors like new energy vehicles, lithium batteries, and photovoltaics. Service robots are now being used in a variety of industries, including catering, medical, health, senior care, domestic services, and security. Dedicated robots are becoming more important in agriculture and forestry, emergency response, environmental protection, and scientific surveying. China has sustained significant growth in industrial robot sales since surpassing Japan to have the world's largest inventory of robots for the first time in 2016. In 2022, China's robotics sector generated approximately 170 billion yuan in revenue. By 2022, China had 1.357 million industrial robots, accounting for 52.5% of the global market share, with an annual composite growth rate of 28.8% during the decade, up from 14% in 2012. China manufactured 429,500 sets of industrial robots in 2023, exceeding 400,000 sets for the second year in a row, as well as 7.963 million service robots, a 23.3% increase over the previous year. China's overall imports and exports of industrial robots totaled 2.61 billion US dollars in 2022, and 2.66 billion US dollars in the first ten months of 2023, a 23% increase year on year[1].

4. New Stage for the Sophistication of Industrial Structure

4.1 China's Economy Has Shifted to A Service-Based Development Stage

Economic growth has catalyzed industrial upgrading. For the first time in 2012, China's value-added in the service sector as a share of GDP surpassed that of the secondary industry. As a historic transition, the tertiary industry has supplanted the secondary industry as the top driver of China's economic growth, with an increasing share thereafter. In 2015, China's service sector accounted for 50.8% of GDP, exceeding 50% for the first time. In 2023, the service sector's value-added accounted for 54.6% of China's economy and contributed 60.2% of its GDP growth. With a more stable "tertiary-secondary-primary" industrial structure, China's economy has evolved into a service-based modern economy (see Figure 3).

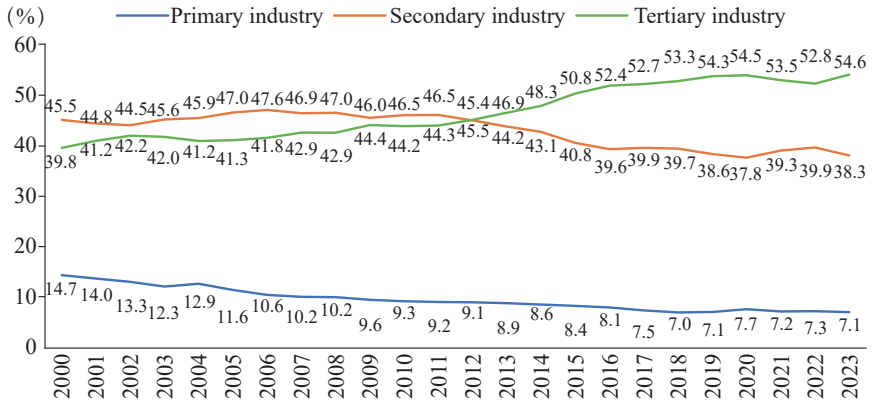

Figure 3: Changes in the Structure of China's Primary, Secondary and Tertiary Industries

Source: Compiled from the *China Statistical Yearbook* (2023) and the *Statistical Communiqué of the People's Republic of China on the 2023 National Economic and Social Development*.

[1] Source: (i) Sales and number of installed robots: *World Robotics 2023 Report* by the International Federation of Robotics (IFR); (ii) Output of industrial robots is based on *Key Manufacturing Data of Large Industrial Enterprises from January to December*. The growth in service robot manufacturing output is calculated using data from 2022.

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4.2 Continued Improvement in the Service Sector's Internal Structure through Structural Adjustment

Producer services now account for more of China's industrial value-added than life services, and technology- and knowledge-intensive services have expanded considerably. In 2022, China's producer services had a value-added of 36.4503 trillion yuan, accounting for 57.3% of the service industry (see Figure 4). In 2023, finance, information transmission, software and IT services, leasing, and commercial services made up 27.8%, 13.8%, and 11.3%, respectively. Modern services and knowledge-intensive services are rapidly emerging as new cornerstones of China's service sector.

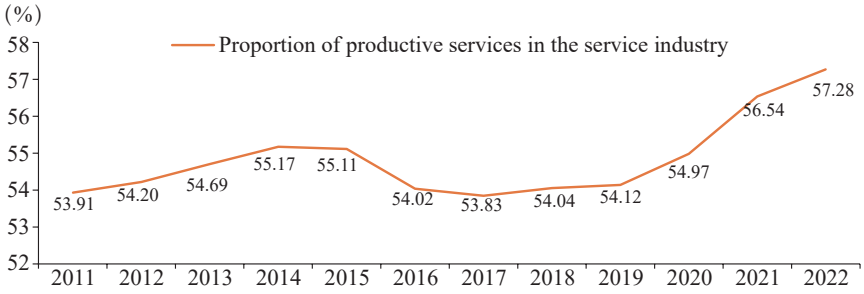

Figure 4: Changes in the Proportion of Productive Services in the Service Industry from 2011 to 2022

Source: Author's calculation.

4.3 High-Tech Sectors Became the Key Drivers of China's Industrial Development

Between 2018 and 2023, investments in China's high-tech sectors grew at an annual average rate of more than 10%, far above national fixed-asset investment growth rates. Massive expenditures have aided the transformation and upgrade of high-tech industries. In 2023, investments in China's high-tech industries rose by 10.3%, above the national average fixed asset investment growth rate by 7.3 percentage points. Investments in high-tech manufacturing and services climbed by 9.9% and 11.4% year on year, respectively, surpassing overall fixed-asset investment growth by 6.9 and 8.4 percentage points. In the high-tech manufacturing industry, investments in electronics and communications equipment manufacturing, computer and office equipment manufacturing, and aviation, aircraft, and equipment manufacturing rose by 11.1%, 14.5%, and 18.4%, respectively; in high-tech services, investments in e-commerce services and R&D commercialization grew by 29.2% and 31.8%, respectively (Zhai, 2024).

4.4 Industrial Integration Emerged as a Prominent Trend

With the integration of digital and real economies as a new normal, and the integration across advanced manufacturing and modern services and agriculture has entered in a new stage of development. According to the *World Service-based Manufacturing Index Report*, China's service-based manufacturing index for 2021 is 113.71, ranking fourth in the world and demonstrating consistent growth for five years in a row. According to Table 1, by 2023, the Ministry of Industry and Information Technology (MIIT) had issued a list of service-based demonstration manufacturing enterprises in five waves, which includes 372 demonstration enterprises, 225 platforms, and 157 projects. China's manufacturing industry is increasingly service-oriented. In 2022, the tertiary industry accounted for 25.7% of the value-added in agricultural and related sectors. Distribution services for agriculture, forestry, livestock breeding, and fishery, as well as related products, accounted for 14.1%. With the help of modern services, smallholders can now take part in modern agriculture, and such services are crucial to the growth and success of modern agriculture.

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Table 1: Numbers of Service-oriented Manufacturing Demonstration Enterprise, Platforms, and Projects from the First to Fifth Batches

	First batch	Second batch	Third batch	Fourth batch	Fifth batch
Demonstration enterprises	30	33	88	111	110
Demonstration platforms	30	31	56	57	51
Demonstration projects	60	50	25	22	/

Source: Compiled by the author based on the list published on the official website of the Ministry of Industry and Information Technology.

4.5 Integration between Digital and Real Economy

In recent years, significant progress has been achieved in integrating the digital and real economies, as seen by the emergence of the new economy, which is driven by new industries, business models, and paradigms. From 2015 to 2022, China's new economy maintained an annual average value-added growth rate of 10.9%, which was 2.5 percentage points faster than GDP growth over the same time. In 2022, China's new economy had a value-added of 21.01 trillion yuan, accounting for 17.36% of GDP, up 2.6 percentage points from 2015 (see Figure 5). The new economy accounted for 4.0%, 44.2%, and 51.8% of China's primary, secondary, and tertiary industries, respectively. The new economy encompasses modern agriculture, forestry, livestock and fishery, advanced manufacturing, Internet and IT services, innovation and entrepreneurial services, and modern producer services, all of which contribute greatly to China's high-quality economic development and industrial upgrading. Notably, new business models in culture, tourism, and ecological services swept the country by storm in 2023. In 2023, the 16 sectors of the culture industry with distinguishing characteristics of the new business models generated a business revenue of 5,239.5 billion yuan, up 15.3% from the year before. New business models accounted for 70.9% of the business revenue growth of large culture businesses. "Zibo BBQ", winter sports, and ice-snow tourism went viral on social media. New business models for culture, sports, and ecological services have unleashed great potential for domestic economic circulation.

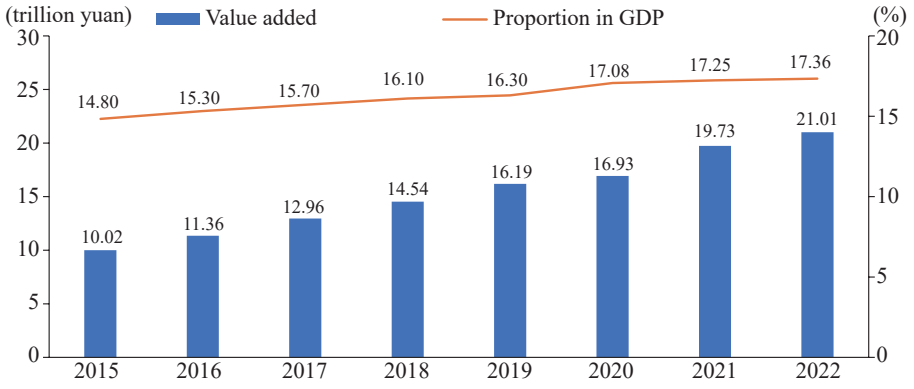

Figure 5: Value-added of the "Three New" Economy and Its Proportion in GDP from 2015 to 2022
Source: National Bureau of Statistics.

5. Digital Economy Fosters New Dynamism

5.1 Fast Growth in the Digital Economy Scale and Penetration Rate

According to the China Academy of Information and Communications Technology (CAICT),

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China's digital economy grew by 10.3% year on year to 50.2 trillion yuan, accounting for 41.5% of China's GDP, equal to the share of the secondary sector. Globally, China's digital economy ranks among the top in terms of both value and share (see Figure 6). China's industrial digital economy has a penetration rate of 24%, and industrial enterprises have significantly boosted their use of CNC-controlled essential operations and digital R&D design tools. The digital economy's penetration rate in the service sectors was 44.7%. Agricultural digitalization spread throughout industrial chains, with a 10.5% penetration rate in the agricultural digital economy.

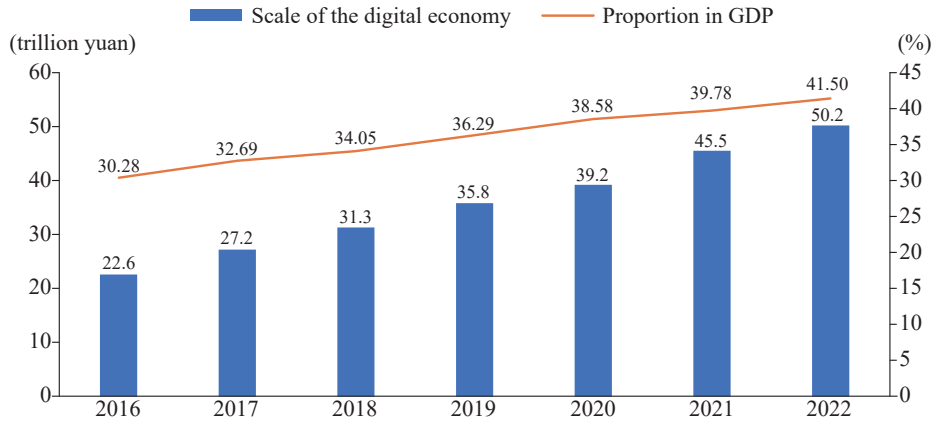

Figure 6: Development of China's Digital Economy

Source: Compiled from the annual reports published by the China Academy of Information and Communications Technology.

5.2 Data Factors Empowering Various Sectors

Today's world is in the midst of a fresh wave of technological and industrial revolutions. Data, as a new production factor, has entered the production function and is becoming ever more important for industrial development. It is a key factor for fostering new quality productive forces. In 2022, China contributed 10.5% of the world's total data generation, ranking second in the world, while its data storage accounted for 14.4% of the world's total. China's big data industry generated 1.57 trillion yuan in output value. Data collection, labeling, analysis, and storage have transformed data into a valuable resource. The data labeling sector has formed three industrial clusters in Beijing, the Yangtze River Delta, and the Chengdu-Chongqing region, resulting in technology spillover effects in neighboring regions. According to the *"Data Factor×" Three-Year Action Plan (2024-2026)*, China aims to implement the "data factor×" across 12 sectors, including industrial manufacturing, modern agriculture, trade circulation, and transportation. Based on the nation's extensive data resources, diverse application scenarios, and vast market size, this initiative seeks to enhance total factor productivity (TFP) by integrating data with labor and capital factors and utilizing data flow to guide technology, talent, capital, and material flows. By transcending the limitations of traditional factors, the Plan is designed to promote the multi-scenario application and multi-entity reusability of data. This will involve developing new products and services based on the data factor and exploring fresh avenues for economic growth. Furthermore, the Plan aims to expand the scale of data and diversify data categories to facilitate innovation and upgrade production tools, thereby fostering new industries and business models while injecting new dynamism into economic development (National Data Administration, et al., 2024).

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5.3 Industrial Transformation and Upgrading Catalyzed by "AI+"

The concept of "AI+" first mentioned in *the 2024 Government Work Report* suggests extensive AI applications across sectors. It aims to integrate technical and industrial innovations to create new products, services, and business models. "AI+" is poised to transform traditional industries and socio-economic structures, shaping new dynamics and strengths for high-quality development. China has over 4,400 AI-related companies with around 10,000 digital workshops and smart factories, representing a core AI industry worth 500 billion yuan. According to the CCID Academy for Industry and Information Technology at the Ministry of Industry and Information Technology (MIIT), 15% of Chinese enterprises have adopted generative AI in 2023. The manufacturing, retail, telecom, and healthcare industries have experienced a surge in the adoption of generative AI, which has a market of 14.4 trillion yuan. By 2035, generative AI is expected to contribute 90 trillion yuan to the global economy, with China's contribution to exceed 30 trillion yuan (Du, 2024).

5.4 Intelligent Manufacturing Made Headway in Industrial Sector

Rapid advancements in intelligent manufacturing have fueled automation-related industries. In 2023, the value-added in China's manufacturing of electrical and electromagnetic components rose by 29.8% and 10.3%, respectively. Intelligent manufacturing applications have become more widespread and productive. Over 40% of Chinese manufacturing firms have adopted digital and network-based manufacturing processes, propelling China to the fifth place in the world in terms of industrial robot density. In the first half of 2022, China sold 131,000 manufacturing robots for 3 trillion yuan, meeting more than half of the market demand. China had built 62 "lighthouse factories" by the end of 2023, or 40% of the world's total, as well as 421 national demonstration factories of intelligent manufacturing and over 10,000 provincial digital and smart factories (Wang, 2024).

5.5 New Service Business Models Such as E-Commerce and Online Marketing

China's e-commerce market has steadily expanded over the years. In 2023, China's e-commerce transaction volume was 46.83 trillion yuan, increasing 9.4% from the previous year (NBS, 2024). According to Ministry of Commerce data, China's online retail sales volume in 2023 totaled 15.43 trillion yuan, up 11.0% from the previous year, making it the world's largest online retail sales market for the 11th consecutive year[2]. In 2023, China's online sales of physical products climbed to 27.6% of total social consumer goods retail volume, reaching a new record. Continuous progress has been achieved in the integration of the real and digital economies, as well as the online and brick-and-mortar sales channels. New business modes, such as online platforms and e-commerce, are emerging as key drivers of industrial upgrading and economic vibrancy. In 2023, the online sales volumes of tourism, culture and entertainment, and catering increased by 237.5%, 102.2%, and 29.1%, respectively, contributing 23.5% to online retail sales volume and boosting online retail sales by 2.6 percentage points (Information Office of the Ministry of Commerce, 2024). In 2023, China's courier service exceeded 130 billion parcels, with a monthly average of over 10 billion parcels, a 19.5% increase from the previous year.

[2] The e-commerce transaction volume refers to the transaction amount of goods and services conducted through e-commerce transaction platforms (including both proprietary platforms of companies and third-party platforms), encompassing transactions with both entities and individuals. Online retail sales refer to the retail transaction amount of goods and services conducted through public network trading platforms (mainly platforms dealing in tangible goods, including proprietary websites and third-party platforms). The growth rates of both e-commerce transaction volume and online retail sales are calculated on a comparable basis.

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6. New Miracles in Green Economic Development

The Report to the 20th National Congress of the Communist Party of China (CPC) states, "Chinese modernization is the modernization in which man and nature coexist in harmony". Green development, with equal emphasis on environmental benefits and economic efficiency, is a defining feature of Chinese modernization. In 2020, the Chinese government made a solemn pledge to "peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060". This commitment reflects the determination to pursue a path of green, low-carbon, and high-quality development, aiming to achieve the highest reduction in carbon intensity globally and promote the global green development process. In recent years, China has established the concept that "green mountains are gold mountains" and has made consistent efforts to reduce carbon emissions and pollution while expanding greenery and economic growth. The green and low-carbon shift has benefited both "gold mountains" and "green mountains".

6.1 Promoting Green Industrial Transition through Technological Innovation

By the end of 2021, China had filed 60,000 valid innovation patents for the new energy industry and 49,000 valid innovation patents for energy conservation and environmental protection, representing 1.7 and 1.6 times the levels at the end of 2017. Between 2011 and 2020, China filed over 60% of environmental technology innovation patents in the world, making it the most proactive country for environmental technology innovations (Information Office of the State Council of China, 2023). In recent years, China has seen a steady increase in its energy and resource efficiency, as well as continuous advances in the green manufacturing system. Green industrial development has been accelerated by technological progress in new energy, pollution reduction, and environmental monitoring that have reached internationally advanced levels.

6.2 Leading in New Energy Products

In 2023, new energy products began to spearhead China's green development, transforming into a new driver of economic growth. In 2023, China's manufacturing output of electric vehicles (EVs), lithium batteries, and solar panels increased sharply from the previous year. China's manufacturing output of wind turbines, hydropower turbines, and charging facilities increased by 28.7%, 35.3%, and 36.9% from 2023, respectively, while the manufacturing output of ultra-clear glass for solar panels, carbon fiber composite materials, and bio-based chemical fibers increased by 58.6%, 57.1%, and 50.7%, respectively (Tang, 2024). In 2023, China's manufacturing output of polycrystalline silicon, silicon wafers, batteries, and components accounted for more than 70% of the global total (China Youth Network, 2024).

6.3 Thriving Renewable Energy Industry

According to the National Energy Administration (NEA), China's newly installed renewable energy capacity reached 152 million kW in 2022, accounting for 76.2% of the country's newly installed power generation capacity. The newly installed capacity of wind power, solar power, biomass power, conventional hydropower, and pumped storage hydropower (PSH) grew by 37.63 million kW, 87.41 million kW, 3.34 million kW, 15.07 million kW, and 8.8 million kW respectively. By the end of 2022, China's installed renewable energy capacity surpassed 1.2 billion kW, totaling 1.213 billion kW and accounting for 47.3% of its total installed generation capacity. Specifically, China's wind, solar, biomass, conventional hydropower, and PSH power had reached installed capacities of 365 million kW, 393 million kW, 41 million kW, 368 million kW, and 45 million kW, respectively (NDRC Department of Resource Conservation and Environmental Protection, 2023). In 2023, China's installed

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renewable energy capacity expanded to 1.45 billion kW, accounting for more than half of the country's total installed power generation capacity for the first time ever. China leads the world in wind, solar, hydropower, and biomass power installed capacities, becoming a major supplier of wind and photovoltaic equipment and power batteries while also reducing renewable energy deployment costs globally. Many parts of China had integrated smart zero-carbon power plants completed by 2023; such decentralized zero-carbon power plants, which prioritize green electricity from wind, solar, and hydropower while burning no coal, congregate scattered sources of power generated from factories, shopping malls, and households to feed zero-carbon electric power to the power grid via smart modulation (Bai, 2024).

6.4 Green Modern Industrial System Initially Took Shape

Green technology is rapidly replacing resource-intensive and polluting processes in traditional sectors. Great efforts have been made to cultivate emerging green industries, inspire dynamism for green development, integrate emerging technologies such as AI and big data into green industries, and promote green industry with new quality productive forces. Green factories, green industrial chains, and green industrial parks have been built to establish complete green product supply chains, from raw materials to finished products.

7. New Strides in Industrial Internationalization

In recent years, China has opened up at a higher level, established an open new economic system, and embraced the Belt and Road Initiative (BRI), providing opportunities for other nations with its own development. China's overall imports and exports of goods in 2022 reached 6.31 trillion US dollars, more than 13 times the amount in 2000. China has endeavored to enhance BRI economic and trade cooperation, increasing its imports and exports with BRI countries to 46.6% of its total trade volume in 2023. With new platforms for opening up under construction, the share of China's imports and exports through free trade experiment zones has risen to 18.4% (Sheng, 2024).

7.1 High-Tech Exports Became China's Primary Export Products

With an increasing international competitiveness, China has completed the transition from processing trade and labor-intensive exports to general trade, electromechanical, and high-tech exports. As shown in Table 2, in 2023, China exported 13.92 trillion yuan worth of electromechanical products, accounting for 58.6% of its total exports, outshining its labor-intensive exports worth 4.11 trillion yuan, or 17.3%. Electric vehicles (EVs), lithium batteries, and solar panels have become the "new big three" of China's foreign trade. According to the General Administration of Customs, China's "new big three" exports surpassed 1 trillion yuan for the first time in 2023, reaching 1.06 trillion yuan, up 29.9%, indicating a considerable growth in its international market share.

Table 2: China's Product Export Trade from 2012 to 2023

	Goods exports Total amount (100million yuan)	Including: General trade (100million yuan)	%	Processing trade (100million yuan)	%	Electromechanical products (100million yuan)	%	High-Tech products (100million yuan)	%
2012	129337	62368	0.48	54464	0.42	74450	0.58	37951	0.29
2013	136845	67351	0.49	53292	0.39	78356	0.57	40894	0.30
2014	143912	73944	0.51	54320	0.38	80527	0.56	40570	0.28
2015	141255	75456	0.53	49553	0.35	81421	0.58	40737	0.29

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Table 2 Continued

	Goods exports Total amount (100million yuan)	Including: General trade (100million yuan)	%	Processing trade (100million yuan)	%	Electromechanical products (100million yuan)	%	High-Tech products (100million yuan)	%
2016	138455	74601	0.54	47237	0.34	79820	0.58	39876	0.29
2017	153321	83325	0.54	51381	0.34	89465	0.58	45150	0.29
2018	164177	92405	0.56	52676	0.32	96457	0.59	49374	0.30
2019	172342	99546	0.58	50729	0.29	100631	0.58	50427	0.29
2020	179326	106460	0.59	48589	0.27	106608	0.59	53692	0.30
2021	217348	132445	0.61	53378	0.25	128286	0.59	63266	0.29
2022	239654	152468	0.64	53952	0.23	136973	0.57	63391	0.26
2023	237726	153530	0.65	49062	0.21	139196	0.59	59279	0.25

Source: Compiled based on *Statistical Communiqué of the People's Republic of China on National Economic and Social Development* from 2012 to 2022.

7.2 China's ODIs Rank among the Highest in the World

In 2022, China's ODIs totaled 163.12 billion US dollars, placing it second in the world and among the top three for 11 years in a row, and accounting for more than 10% of worldwide ODIs for seven years (see Figure 7). China's ODI inventory reached 2.75 trillion US dollars by the end of 2022, placing it among the top three in the world for the sixth consecutive year (Ministry of Commerce of the People's Republic of China et al., 2023). Between 2013 and 2021, China made ODIs in the BRI countries totaling 161.3 billion US dollars, with an annual average growth rate of 5.4%. BRI countries have emerged as preferred investment destinations for Chinese firms. Twenty years ago, traditional industries like mining and manufacturing dominated China's ODIs. Today, the tertiary industry serves as the backbone. China's ODIs in the information industry and scientific research and technical services have grown at 32% and 20% during the past ten years, respectively. In 2022, China made ODIs in 18 industrial sectors totaling more than 10 billion US dollars, including mining, manufacturing, transportation, finance, retail and wholesale, leasing, and commercial services. In 2020, overseas Chinese-funded firms paid 44.5 billion US dollars in taxes to their host countries and regions. In the same year, 2.188 million foreign workers were engaged by overseas Chinese-funded firms (Wang, 2021). Chinese firms have made vital contributions to global win-win cooperation, common progress, and prosperity.

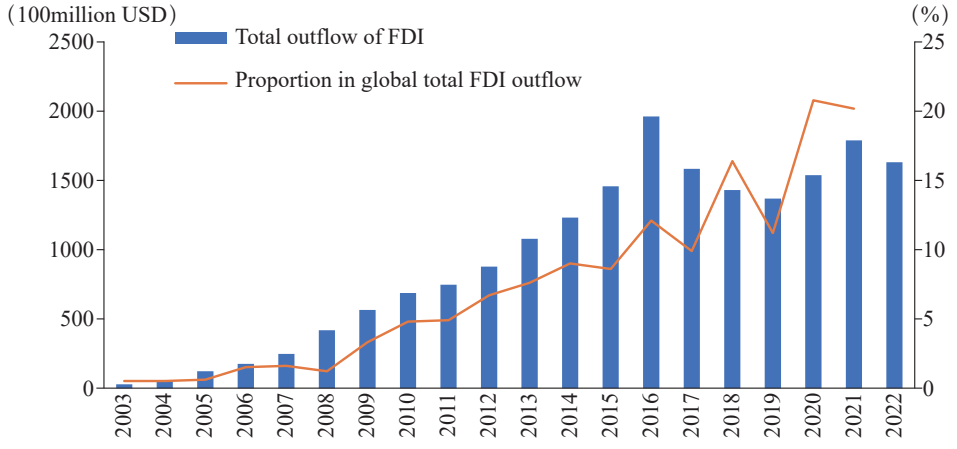

Figure 7: China's FDI from 2003 to 2022

Source: National Bureau of Statistics.

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7.3 Industrial Internationalization Refocused from "Going Global" to "Integrating Locally"

Chinese companies have gone through three stages of internationalization, which include the internationalization of products, capital, and capabilities. Among them, the internationalization of capabilities implies that Chinese firms must be able to operate in foreign markets in a localized manner. Over the past few decades, Chinese businesses have progressed from product export to the internationalization of products, capital, business model, marketing strategy, and technologies. Previously, Chinese companies focused on exporting goods, lacked coordination when investing abroad, and acquired foreign businesses hastily. Nowadays, they have turned their focus to exporting business concepts, formed industry coalitions, and begun to integrate with acquired businesses. These changes reflect a general trend that Chinese firms are heavily involved in, and even transforming, global value chains in order to develop localized operations in those markets. For example, about 90% of Chinese companies on the *Fortune China 500* list have conducted various forms of international commerce in 2021, and roughly half of those businesses continue to prioritize overseas business growth as a strategic priority. While only 10% of them prioritize overseas mergers and acquisitions, the vast majority of those Chinese companies have attached importance to localized overseas operations: 29% of them prioritize overseas marketing capabilities, 24% of them prioritize overseas supply chains, and 11% of them prioritize overseas technology (LinkedIn China, Boston Consulting, 2022).

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