摘　要

面对日益严峻的气候问题，持续增长的碳排放已成为当前中国发展急需解决的现实问题。中国制造业作为中国经济的重要支柱和全球制造业的关键力量，面临着高能耗、高污染等生态环境问题的严峻挑战，尤其是碳排放问题日益突出。党的二十大报告指出，推进新型工业化，加快建设制造强国、质量强国、数字中国。在数字化快速发展的背景下，制造业的生产和组织方式发生了巨大变革，这为中国碳减排提供了新的研究思路。本文围绕数字化是否能够降低制造业碳排放强度这一问题展开研究，为数字化与环境领域的研究提供了新的视角，也为实现“双碳”目标提供决策参考。

本文通过梳理数字化与碳排放相关文献，对数字化水平与制造业碳排放强度之间的关系进行理论分析，提出相应的研究假设。实证分析方面，本文运用 2002—2017 年中国 30 个省份及 2002—2020 年 16 个制造业细分行业的面板数据，利用投入产出表计算完全依赖度以构建数字化指标，采用 IPCC 方法测算出制造业碳排放量，进一步计算得到碳排放强度数据，并分别对其进行对比分析。同时，本文通过构建固定效应模型和中介效应模型，探讨了数字化水平对制造业碳排放强度的直接影响和中介作用机制，并进行了区域异质性和行业异质性分析。

研究结果表明：(1)制造业数字化水平呈现波动上升趋势，而制造业碳排放强度则呈现出逐年下降趋势。具体来看，资本密集型和西部地区的制造业碳排放强度较高；技术密集型制造业和东部地区的数字化水平相对较高。(2)实证结果表明，数字化水平的提升显著降低了制造业碳排放强度。这一结论在考虑了样本的内生性、极端值的影响、替换核心解释变量和被解释变量后依旧稳健。(3)机制检验显示，数字化水平的提升可以通过降低能源强度，促进产业结构升级两种途径降低制造业碳排放强度，且降低能源强度的作用效果要略微优于促进产业结构升级。(4)数字化水平对制造业碳排放强度的影响存在区域及行业异质性。数字化水平对降低东、西部地区制造业碳排放强度的作用更明显；数字化水平的提升能够显著降低资本密集型和技术密集型制造业碳排放强度，但对劳动密集型制造业碳排放强度的影响相反。

因此，本文提出以下政策建议：第一、制造业亟需积极推进数字化转型，促进数字元素的深度融合。第二、为了最大程度发挥数字化带来的减排效果，需要采用差别化的数字化低碳解决方案，以满足不同制造业的需求。第三、数字化转型需立足区域发展差异，因地制宜。政策制定者应考虑向中部地区施加适当的政策倾斜及鼓励，消除地区间的不对等关系，推动全国范围内的碳减排。

关键词：碳排放强度；数字化；数字经济；制造业；投入视角

Abstract

Facing the increasingly severe climate issues, the continuous growth of carbon emissions has become an urgent and pressing matter for China's current development. As a vital pillar of the Chinese economy and a crucial force in global manufacturing, the Chinese manufacturing industry confronts daunting challenges in terms of high energy consumption, pollution, and particularly the escalating issue of carbon emissions. The report from the 20th National Congress of the Communist Party of China emphasized the advancement of new industrialization and the acceleration of building a manufacturing powerhouse, a nation strong in quality, and a digital China. Against the backdrop of rapid digitalization, significant transformations have occurred in the production and organizational methods of the manufacturing industry, offering new research perspectives for China's carbon reduction efforts.

This thesis conducts a theoretical analysis of the relationship between digitalization levels and manufacturing industry carbon emissions based on a review of relevant literature, proposing corresponding research hypotheses. In terms of empirical analysis, panel data from 30 provinces in China from 2002 to 2017 and 16 detailed manufacturing industry sectors from 2002 to 2020 are utilized. A digitalization index is constructed using input-output tables to calculate complete dependence, while manufacturing industry carbon emissions are estimated using the IPCC method. Further analysis involves the calculation of carbon emission intensity data, followed by comparative analysis. Additionally, this thesis explores the direct impact of digitalization levels on manufacturing industry carbon emissions through the construction of fixed effects models and mediation effects models, alongside regional and sectoral heterogeneity analysis.

The research findings indicate that: (1) The digitalization level of the manufacturing industry shows a fluctuating upward trend, while carbon emissions intensity exhibits a declining trend year by year. Specifically, capital-intensive manufacturing and the western regions have higher carbon emissions intensity, whereas technology-intensive manufacturing and the eastern regions have relatively higher digitalization levels. (2) Empirical results demonstrate that the increase in digitalization levels significantly reduces manufacturing industry carbon emissions intensity. This conclusion remains robust after considering endogeneity, the influence of extreme values, and the substitution of core explanatory variables and dependent variables. (3) Mechanism tests reveal that the increase in

digitalization levels can reduce manufacturing industry carbon emissions intensity through two pathways: lowering energy intensity and promoting industrial structural upgrading, with the effect of reducing energy intensity slightly superior to that of promoting industrial structural upgrading. (4) The impact of digitalization levels on manufacturing industry carbon emissions intensity exhibits regional and sectoral heterogeneity. The effect of digitalization levels on reducing carbon emissions intensity in the eastern and western regions is more pronounced. The increase in digitalization levels can significantly reduce the carbon emissions intensity of capital-intensive and technology-intensive manufacturing, but it has the opposite effect on labor-intensive manufacturing.

Therefore, this thesis proposes the following policy recommendations: Firstly, the manufacturing industry urgently needs to actively promote digital transformation and facilitate the deep integration of digital elements. Secondly, to maximize the emission reduction effect brought about by digitalization, differentiated digital low-carbon solutions should be adopted to meet the needs of different manufacturing industries. Thirdly, digital transformation should be based on regional development differences and tailored to local conditions. Policymakers should consider applying appropriate policy inclinations and incentives to the central regions, eliminating regional inequalities, and promoting nationwide carbon emission reductions.

Key Words: Carbon emission intensity; Digitalization; Digital economy; Manufacturing industry; Perspective Based on Input

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