摘　要

当前，中国劳动年龄人口减少导致人口红利逐渐消失与老龄化问题加剧，成为影响社会发展的一个显著问题。据测算，中国老年人口抚养比将在十四五期间达到中度老龄化水平，在 2035 年左右达到重度老龄化水平。国际经验与理论研究都表明，人口老龄化程度的不断加深以及劳动年龄人口锐减，会对经济造成严重的负面冲击。因此，有必要探寻老龄化背景下缓解劳动力短缺问题的有效之策。党的二十大报告中强调发展人工智能可以培养新的经济增长引擎，促进产业升级，推动我国经济高质量发展。人工智能技术的广泛应用，既能够降低生产对劳动力的需求，更可以提高社会全要素生产率，促进国家经济发展。因此，进一步探讨人工智能新技术、劳动力、资本等生产要素的相互作用尤为重要。本文首先分析了老龄化加剧的时代背景，人工智能应用备受争议的现实状况。其次，对人工智能与老龄化的相关文献进行了梳理和综述，并详细介绍了与之相关的经济增长理论、人力资本理论、人工智能理论等。然后介绍了本文建模使用的数据与变量，对核心变量进行了多角度的描述性分析。在前人研究和理论基础上，利用柯布道格拉斯生产函数对机器人密度、劳动年龄人口数、固定资产投资等要素建立了模型，对人工智能的替代能力进行了测算。继而利用 ARMA 模型对人工智能的发展进行了预测。最终，结合文献与实证结论，提出了关于人工智能发展和完善相应社保政策的建议。

本文利用中国 2006—2019 年 31 个省的面板数据进行了实证分析，研究结论如下：目前机器人密度每上升 1%，可以替代 0.14～0.18 个劳动力。利用滞后的自变量对因变量进行稳健性检验，发现人工智能对于经济的作用具有一定的滞后性，智能红利在智能化后的数年才能逐步实现。利用 ARMA 模型对中国机器人密度进行预测，发现 2024 年机器人密度比 2006 年的多 274 倍，可见人工智能技术发展迅猛。虽然，目前替代能力不高，人工智能缓解劳动力短缺问题的效果并不明显，但未来的影响却不可估量。因此，提出如下政策建议：（1）合理推进人工智能发展。完善要素市场，保持和推动诱导式创新；倾斜金融政策，提供资金保障；加强教育培训，积累智能化生产所需的人力资本。理性把握人工智能的推动速度，因地制宜制定引进政策；科学顶层设计，充分考虑推进速度与劳动力市场的承载能力；促进产业升级与多元化，助力经济高质量发展。（2）完善相关社会保障政策。公平就业环境，开发女性劳动力，提高女性劳动者参与率；注重智能化养老设备的研发以缓解养老压力，缓解老龄化困境；完善失业保障，立法保障失业者权益，加强失业培训，合理补偿制度；针对新兴岗位制定工伤保险政策，明确社会保险参保资格与缴费主体；适时征收机器人税，积累社会财富；制定更公平的分配政策，促进社会和谐发展。

关键词：人工智能；劳动年龄人口；老龄化；社会保障

Abstract

At present, the decline in China's working-age population has led to the gradual disappearance of the demographic dividend and the aging problem, which has become a notable issue affecting social development. It is estimated that the dependency ratio of China's elderly population will reach a medium level of aging during the 14th Five-Year Plan period, and will reach a heavy level of aging around 2035. International experience and theoretical studies have shown that the deepening of population aging and the sharp decline in the working-age population will cause serious negative impacts on the economy. Therefore, it is necessary to explore effective measures to alleviate the problem of labor shortage in the context of aging. The report of the 20th Party Congress emphasizes that the development of artificial intelligence can cultivate new engines of economic growth, promote industrial upgrading, and push forward the high-quality development of China's economy. The wide application of AI technology can not only reduce the demand for labor in production, but also improve the total factor productivity of society and promote the economic development of the country. Therefore, it is particularly important to further explore the interaction of new AI technology, labor, capital and other factors of production. This thesis firstly analyzes the era background of aging aggravation and the reality of the controversial application of artificial intelligence. Secondly, it combs and reviews the relevant literature on AI and aging, and introduces in detail the economic growth theory, human capital theory, and artificial intelligence theory related to it. Then the data and variables used in the modeling of this thesis are introduced, and the core variables are analyzed descriptively from multiple perspectives. On the basis of previous studies and theories, the substitution capacity of AI is measured by modeling the factors such as robot density, the number of working-age population, and fixed asset investment using the Cobb Douglas production function. Following that, the development of artificial intelligence was predicted using the ARMA model. Finally, combining the literature and empirical findings, recommendations on the development of AI and the improvement of the corresponding social security policies are put forward.

This thesis conducted an empirical analysis using panel data from 31 provinces in China from 2006-2019, and the study concludes the following: at present, every 1% rise in the density of robots can replace 0.14 to 0.18 laborers. The robustness test of the dependent variable using the lagged independent variable reveals that the effect of artificial intelligence on the economy has a certain lag, and the intelligence dividend can only be gradually realized several years after intelligence. Using the ARMA model to predict the density of robots in China, it is found that

the density of robots in 2024 is 274 times more than that in 2006, which shows the rapid development of AI technology. Although, at present, the substitution capacity is not high and the effect of AI in alleviating the labor shortage problem is not obvious, the future impact is immeasurable. Therefore, the following policy recommendations are put forward: (1) Rationally promote the development of artificial intelligence. Improve the factor market to maintain and promote induced innovation; tilt financial policies to provide financial security; strengthen education and training to accumulate human capital needed for intelligent production. Rationally grasp the speed of AI promotion and formulate introduction policies according to local conditions; scientific top-level design, fully consider the speed of promotion and the carrying capacity of the labor market; promote industrial upgrading and diversification, and help the economy develop with high quality. (2) Improve relevant social security policies. Fair employment environment, develop female labor force, and increase the participation rate of female workers; focus on the research and development of intelligent pension equipment to ease the pressure of old age and alleviate the plight of aging; improve unemployment protection, legislate to protect the rights and interests of the unemployed, strengthen unemployment training, and rationalize the compensation system; formulate the policy of industrial injury insurance for new jobs, and clarify the eligibility for social insurance and the main body of contributions; levy a robotic tax at an appropriate time, and accumulate social wealth; formulate a more equitable distribution policy; and develop a more equitable distribution policy. wealth; and formulate a fairer distribution policy to promote harmonious social development.

Key Words: Artificial intelligence; Working-age population; Aging; Social security

目 录

TABLE OF CONTENTS

图目录

表目录

1 绪论

1.1 研究背景及意义

1.1.1 研究背景

国家卫健委提出，十四五时期我国 60 岁及以上人口将超过 3 亿，占总人口比重将达到 20%，意味着中国将进入中度人口老龄化阶段；2035 年左右，中国 65 岁以上老年人口将超过 4 亿，占总人口比重超过 30%，步入重度人口老龄化阶段[①]。通过人口预测估算中国未来的人口规模，发现其具有“四降三升”态势[27]。具体表现为人口总量依旧呈现上升态势，其中，老年人口增速加快，劳动年龄人口、0～14 岁少儿人口持续减少，且育龄期女性人口、年均出生人口不断走低。这将导致我国老年人口抚养比即老龄化程度不断提高，人口负担持续加剧。我国人口学会副会长原新曾指出，2022 年开始，在第二个婴儿潮即 1962—1975 年出生的人口会陆续进入老年人口行列，会导致第二个人口老龄化高潮，这将比第一次人口老龄化高潮持续时间更久，影响力更大。当前到本世纪中叶，我国的社会主义现代化强国建设进入了关键时期，如何积极、科学、有效应对人口老龄化以及劳动力短缺对经济造成的负面影响至关重要。

人工智能问世以来，关于技术进步对就业的影响、智能 AI 替代劳动力等问题就备受关注，既存在机器代人的恐慌，也有科技助力经济发展的期待。2016 年 AlphaGo 打败世界围棋冠军李世石引发全网热议。2021 年 ChatGPT 发布，它不仅能通过学习理解人类语言，而且能根据上下文与人类互动交流，甚至可以撰写邮件、文案、代码等。人类会被机器替代的焦虑思想甚嚣尘上。回看历史，工业革命时期，机器生产逐渐排斥手工劳动，使大批手工业者工资下跌甚至下岗破产，大批工人面临失业危机。1881 年，卢德运动爆发，英国工人通过破坏机器表达了对“机器代人”的焦虑。但是，实践表明，新技术带来的是经济迅速腾飞，物质生活极大丰富以及工作岗位爆炸式增长，人类社会迎来了史无前例的巨大改变。

2017 年习近平总书记在中共十九大报告中指出，中国经济已由高速增长阶段转向高质量发展阶段，正处在转变发展方式、优化经济结构、转换增长动力的攻关期，建设现代化经济体系是跨越关口的迫切要求和中国发展的战略目标。高质量发展要求以质量和效益为价值取向进行发展。然而，目前我国成为世界上老年人口最多的国家，约占世界老年人口总数的 20%，与不断攀升的老年人口数相比，生育意愿低迷，生育率下降，

[①] 数据来源于民政部 2022 年第四季度例行新闻发布会回答记者问。