

Economic Improvement Analysis of Increasing Birth Rate Based on Artificial Intelligence Background

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Abstract. With the persistent low fertility rates in developed countries, there is currently little research on China, an East Asian society characterized by extremely low fertility rates. Low birth rate is an inevitable problem in countries around the world, and despite the promotion of relevant policies in China, the birth rate in China has not been significantly improved. In addition, China has also entered an aging society. The development of China's population involves a wide geographical distribution, a wide range of work wage distribution, a wide urban distribution, low long-term birth rates, challenges in sustained population growth, and imbalanced population structure. This article analyzes the main characteristics and reasons for the decline in population fertility willingness in the context of the vigorous development of artificial intelligence (AI) to enhance economic development. The corresponding measures are proposed to increase the birth rate and address the significant issue of the aging population affecting economic development.

Keywords: Artificial intelligence (AI); Birth rate; Economic Improvement.

1 Introduction

With different social backgrounds in different periods, China's fertility policy has undergone multiple adjustments, and the corresponding population size and structure have also undergone significant changes. Since the implementation of the family planning policy, China's natural population growth rate has been effectively controlled within a relatively reasonable range. However, at the same time, as the hidden dangers of aging population become increasingly prominent, the problem of insufficient labor force is also becoming more and more serious, which affects the rapid growth of economic development. Currently, the labor force has been liberated due to the rapidly developing of AI technology, and related positions have also been replaced by AI technology. Thus, the population growth is to some extent suppressed.

Equation (1) presents Age-specific Fertility Rate (ASFR). It is calculated by dividing the number of births to women in a particular age group by the total number of women in that age group. ASFR provides valuable insights into fertility patterns across different age cohorts. ASFR is given to discuss the demographic characteristics of the population, particularly when describing fertility rates across different age groups. Meanwhile, Total Fertility Rate (TFR) represents the average number of children a woman would give birth to over her lifetime if she

experienced the age-specific fertility rates observed in a particular year. It is calculated by summing up the age-specific fertility rates across all age groups.

$$\begin{cases} ASFR = \frac{B_a}{P_a} \times 1000 \\ TFR = \sum_a ASFR_a \end{cases} \quad (1)$$

where B_a is the number of births to women in age group a , and P_a is the population of women in age group a . $ASFR_a$ is the age-specific fertility rate for age group a .

According to data released by China's National Bureau of Statistics, China entered an aging society in 2000: the population aged 60 and above was 130 million, accounting for 10.2% of the total population. As of the end of 2019, the population aged 60 and above in China reached 254 million, accounting for 18.1% of the total population. According to various social surveys, although the country has introduced a series of policies to encourage childbirth in recent years, the fertility willingness of the age-appropriate population is still not high. In recent years, the number of births has been declining year by year, and the natural population growth rate has continued to decline. According to data from the National Bureau of Statistics, the number of births in 2021 was 10.62 million, with a net increase of 480000 in the total population and a natural population growth rate of 0.34%. China has entered the field of zero population growth and is in the stage of negative population growth^[1, 2], as shown in Fig. 1.

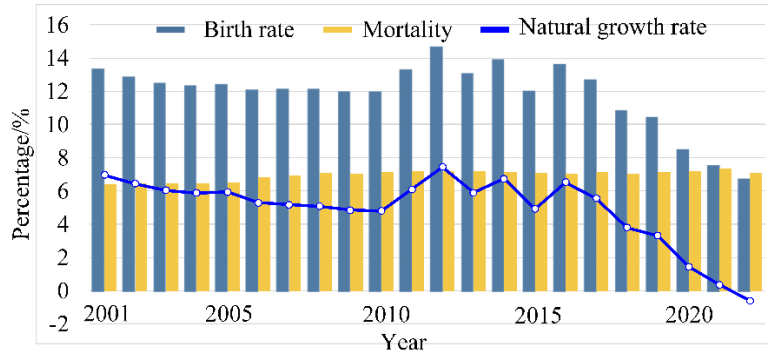


Fig. 1. Changes in China's birth rate, mortality rate, and natural growth rate.

In the face of such social and demographic issues, targeted public policies should be formulated and optimized to promote the increase of fertility willingness among people of childbearing age in all age groups and the transformation towards fertility behavior. Explore the moderate population growth space of zero population growth and negative population growth in the recent stage, and fully grasp the opportunity window of population growth in this stage. This can help to achieve accurate understanding, prepare in advance, respond to population issues, and highlight the key to solving the problem^[2].

In order to promote rapid economic development through further increasing the birth rate in the contemporary era of rapid development and use of AI, this article proposes a strategy to establish a corresponding increase in birth rate that is in line with the characteristics of the times and national conditions. Fig. 2 shows an overview of this article.

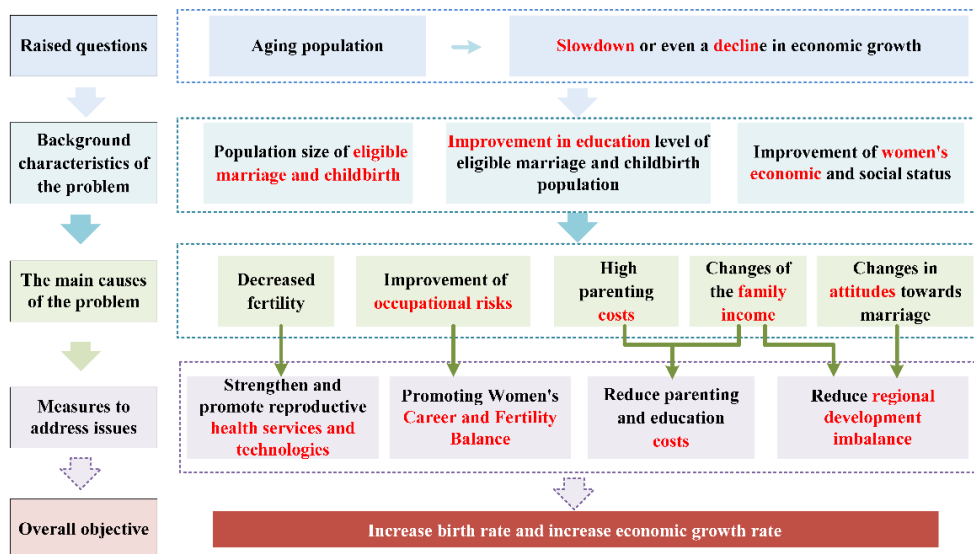


Fig. 2. Outline of this paper.

2 Analysis of the Main Characteristics in the Declining Fertility Intention Based on AI Background

In recent years, a decrease in fertility willingness will lead to a significant decrease in fertility rates. In the era of negative population growth, the fertility rate plays a core role and thus brings about changes in related characteristics.

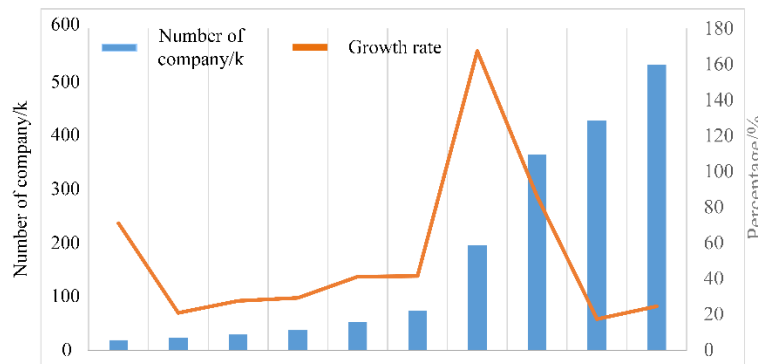


Fig. 3. Number of companies for manufacturing robots.

The fertility rate is not a rigid variable that is difficult to regulate and control like the mortality rate. With the rapid advancement of technology and medical development, AI will continue to break through and develop in the medical field to reduce mortality rates. The development of AI with robots as the main carrier in the future will enter the fast lane, as shown in Fig. 3. In less than five years, the number of companies manufacturing robots has increased fivefold.

Therefore, humanity is about to enter the AI society. In this context, regulating fertility rates with relative elasticity appears to have a more profound impact.

2.1 The Population Size of Eligible Marriage and Childbirth

The eligible population for marriage and childbirth is one of the key factors in increasing the birth rate. The comprehensive changes in the population pattern and proportion of eligible marriage and childbirth will continue to affect the birth rate.

Equation (2) is the logistic growth model for population projection. Equation (2) is used to forecast future population trends based on fertility rates and carrying capacity.

$$N(t) = \frac{K}{1 + \frac{K - N_0}{N_0} e^{-rt}} \quad (2)$$

where $N(t)$ is the population size at time t , K is the carrying capacity, N_0 is the initial population size, r is the intrinsic growth rate, and e is the base of the natural logarithm.

According to the last two population censuses, the size of the eligible population for marriage and childbirth in China is decreasing. From 2010 to 2020, the number of people eligible for marriage aged 20-39 decreased from 444 million to 390 million, a decrease of 53.64 million over a decade; The proportion of the total population has decreased from 35.70% to 27.62%, a decrease of 8.08 percentage points over the past 10 years. Moreover, there is currently a gender imbalance among the eligible population for marriage and childbirth, with more males and fewer females. According to the seventh national population census, in 2020, there were 203 million men aged 20-39 who were eligible for marriage in China, 187 million women of childbearing age, and nearly 15.34 million women were less eligible for marriage than men. This means that some men may face the risk of having children without a spouse, which will seriously affect the birth rate of our country's population [3, 4].

2.2 Improvement in Education Level of Eligible Marriage and Childbirth Population

The education level of eligible marriage and childbirth population is the key point for them to choose whether to have children early. In recent years, the overall education level of China's population has been significantly improved, and the quality of the population has been qualitatively improved, especially in the proportion of people with higher education levels such as universities and above, which has been increasing year by year. According to the seventh national population census, 218 million people in China have a university or higher education, accounting for 15.47% of the total population. The proportion of women aged 20 to 24 with the highest education level is in undergraduate education, accounting for 28.62%. In addition, the proportion of women among graduate students is 50.94%, an increase of 4.86% from 2010 [5]. With the improvement of education level, the time when women enter the workplace and consider marriage and childbirth will be postponed, which compresses the space for childbirth.

2.3 Improvement of Women's Economic and Social Status

The social status of women has been significantly improved, which promotes gender equality and enhances women's sense of happiness. The proportion of women among all employed individuals in society has been raised to over 40% in China. The employment policies and support for women are gradually improving, and the channels for employment are also constantly expanding. The number of women employed is also constantly increasing. The proportion of women participating in decision-making and management is also increasing year by year. Women have the right to participate equally with men in economic and social development, which promotes the interaction between women's labor needs and active participation in social production. Correspondingly, while actively participating in social employment, the willingness to have children continues to decline [6].

3 Micro-level Analysis of Reproductive Decision-Making

While the macro-level data currently developed by China provide valuable insights into population trends, understanding individual reproductive decision-making processes is crucial for developing targeted interventions. In this section, the micro-level factors influencing fertility intentions are delved into in the context of artificial intelligence (AI). Table 1 provides data on individual and community level characteristics of the study participants for further analysis.

Table 1. Individual- and Community-Level Characteristics of Study Participants

Variables	Categories	Number of Participants	Percentage
Age Group	18-25	202	20%
	26-30	298	30%
	31-35	241	24%
	36-40	159	16%
	41-45	100	10%
Marital Status	Married	622	62%
	Single	378	38%
Educational Background	No Educational Background	18	2%
	Secondary School	182	18%
	University	511	51%
	Postgraduate	289	29%

3.1 Methods to Collect the Data from Study Participants

A purposive sampling strategy is employed to select participants for qualitative interviews. Participants were selected based on specific criteria, including age (18-45 years), marital status, and educational background. This ensured representation across diverse demographic groups.

Semi-structured interviews were conducted with participants to explore their attitudes, beliefs, and decision-making processes regarding fertility intentions in the era of artificial intelligence. Interview questions focused on topics such as perceptions of AI technologies, career aspirations, family planning considerations, and access to reproductive health services.

3.2 The Findings from the Study Participants

Perceptions of AI and Family Planning: Participants across all age groups express varying attitudes towards AI's role in family planning. Younger individuals prioritize career aspirations, while older participants are more concerned about balancing work and family life.

Career Aspirations and Fertility Intentions: Career aspirations influence participants' fertility intentions, with many considering the potential impact of childbirth on their professional lives. AI is perceived as offering solutions to manage work-life balance and childcare responsibilities.

Access to Reproductive Health Services: Participants highlight the importance of accessible reproductive health services and express interest in AI-driven solutions for fertility monitoring and assistance. However, concerns about affordability and privacy are also raised.

3.3 How AI impact fertility intentions through various mechanisms as follows:

1). Enhanced Reproductive Technologies: AI can improve the efficiency and success rates of Assisted Reproductive Technology (ART) procedures. Machine learning algorithms can analyze embryonic development patterns to identify embryos with the highest implantation potential, increasing the likelihood of successful pregnancies. AI-driven robotics may also automate certain aspects, reducing human error and improving consistency.

2). Fertility Education and Awareness: AI-powered platforms can provide accessible and tailored educational resources about fertility, reproductive health, and family planning. These platforms can leverage AI chatbots or virtual assistants to answer questions, provide support, and offer personalized advice based on individual circumstances and preferences.

3). Predictive Analytics: AI can analyze demographic, social, and health data to predict individuals' likelihood of experiencing fertility challenges. By identifying risk factors early, AI-powered tools can empower individuals to make informed decisions about family planning and seek appropriate medical interventions when necessary.

4 Analysis of the Reasons for the Decline in Fertility Willingness Under the Influence of AI

The continuous decline in the willingness of the current population to have children involves the subjective concepts, objective physiological conditions, and social objective conditions of the eligible population to have children. The rapid development of AI will expand from current computers, mobile phones, etc. to various items that people can access and use, forming the Internet of Things. The development of AI will be increasingly rapid and dependent.

4.1 Changes in Attitudes Towards Marriage

With the convenience brought by AI technology, people who are suitable for giving birth are increasingly valuing their pursuit of self. They are willing to enjoy a single life and pursue the concept of "not getting married". As more and more young people are unwilling to go out for socializing, it leads to the inability to meet suitable partners for marriage. In addition, as the

proportion of highly educated and high asset women increases, more women are no longer eager to consider marriage and childbirth, which leads to an increase in the age of late marriage. In the seventh national population census in 2020, 280 million people in China had a university or higher education level, accounting for 15.47% of the total population [5].

4.2 Decreased Fertility

With the influence of early China's population and family planning, more and more people choose to give birth relatively late. Age is one of the key factors affecting fertility, and the older one is, the more difficult it is to conceive and the more likely it is to develop reproductive related diseases. As age increases, women's fertility tends to decline after the age of 30, and rapidly declines after the age of 35, while men's fertility begins to decline after the age of 40. Currently, most of the post-80s generation lack confidence in childbirth due to age and physical reasons. Women pursue their careers, but due to the challenges of childbirth in the workplace, many women believe that having children will affect their careers, leading to a continuous delay in the age of first marriage. Meanwhile, due to the increased intensity of overtime and socializing, unhealthy lifestyle habits have led to an increase in modern infertility rates [7].

4.3 Improvement of Occupational Risks

Women bear greater employment pressure than men in employment, and women of childbearing age face employment discrimination. There are different situations for women to enter and promote in the workplace compared to men. Under the same conditions, due to the need for women to take more care of children, families, and other characteristics, it is more difficult for women to obtain positions or promotion opportunities than men. During job interviews, women may encounter inquiries about marriage and childbirth plans, as well as experiences of limited development opportunities after childbirth. The occupational risks associated with childbirth have also become one of the stumbling blocks for women's willingness to have children [8]. In addition, in certain positions, AI and robotics technology can assist tasks with high repeatability requirements, thereby replacing the use of personnel.

4.4 High Parenting Costs

The high cost of childcare is also one of the important factors affecting the age-appropriate population for marriage and childbirth. With the development of the social economy, the cost of raising children is also increasing year by year, making the economic burden on families continue to increase. The cost of prenatal checkups, nutrition, and pregnancy preparations during pregnancy is a preliminary expense. However, the changes and development of families in the process of urban modernization have weakened this relatively traditional way of grandparents providing intergenerational care for their children. In addition, considering the limited housing space in cities and the economic pressure brought about by purchasing houses for families, it has led to the fertility willingness of the age-appropriate childbirth population [9]. The cost and pressure under this parenting method are very high. In addition, the expenses of family education, rising living costs and housing prices, as well as the burden of children's dining expenses, make the entire married and childbearing family no longer willing to have children.

4.5 Changes of the Family Income

Income is one of the important factors affecting the birth rate. When the income level is high, family income can effectively compensate for the increase in fertility costs, and the birth rate will be effectively increased; On the contrary, when income growth slows down and it is difficult to make up for the rising cost of childbirth, the birth rate gradually decreases. In addition, an excessive increase in income levels can lead to families placing more emphasis on the quality of their children rather than the quantity, thereby suppressing fertility rates.

Equation (3) gives the Cost-Benefit Analysis Formula. Cost-Benefit Analysis is a method used to evaluate the financial viability and desirability of a project or policy by comparing the total benefits it generates with the total costs incurred. Net Benefits represent the difference between total benefits and total costs.

$$CB = \frac{\text{Total Benefits}}{\text{Total Costs}} \quad (3)$$

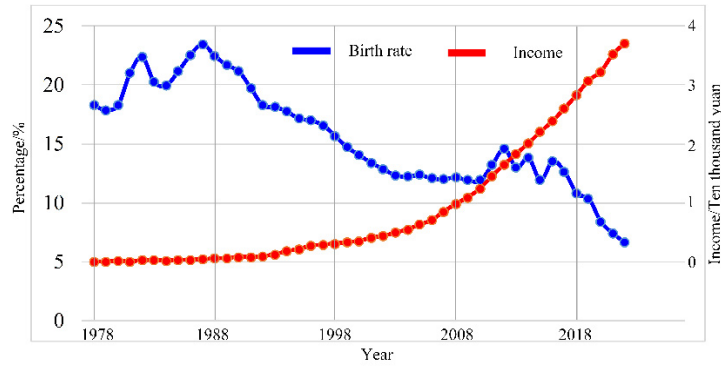


Fig. 4. Changes in income and birth rate.

Fig. 4 reports the trend of changes in China's birth rate and per capita disposable income from 1978 to 2022. From 1978 to 1988, both household income and birth rate showed an upward trend, and the two remained in the same direction of change. Afterwards, the two trends were completely opposite, with household income increasing year by year and the birth rate fluctuating and decreasing.

5 Detailed Measures for Declining Fertility Desire under the Background of Artificial Intelligence

At present, the birth rate in China is continuously declining, and it is necessary to recognize the current trend of population development and provide appropriate intervention. Taking into account the main characteristics and reasons for the negative population growth in China, it is necessary to address the issue of low fertility willingness among eligible couples in the context of AI technology.

5.1 Strengthen and Promote Reproductive Health Services and Technologies ^[10].

5.1.1 Implementation Details:

Firstly, develop a task force comprising healthcare professionals, policymakers, and representatives from ART clinics to formulate guidelines for the inclusion of ART services in medical insurance reimbursement; Secondly, allocate government funding to establish the national maternity medical fund, with clear eligibility criteria, application procedures, and disbursement mechanisms; Thirdly, collaborate with AI experts and reproductive health specialists to design and implement AI-driven educational programs, utilizing interactive online modules, virtual reality simulations, and targeted advertising campaigns.

5.1.2 Evaluation Mechanisms:

Firstly, monitor the number of ART procedures covered by insurance and track the utilization rate of the national maternity medical fund; Subsequently, conduct surveys and focus groups to assess the effectiveness of AI-driven educational programs in increasing awareness and understanding of reproductive health issues among different demographic groups.

5.2. Promoting Women's Career and Fertility Balance ^[11].

5.2.1 Implementation Details

Firstly, enact legislation mandating paid maternity leave and flexible work arrangements for all employers, with penalties for non-compliance; Secondly, establish a dedicated government agency responsible for administering grants and subsidies for women's career development and fertility support initiatives; Thirdly, expand the coverage of maternity insurance to include all women of reproductive age, with a focus on providing comprehensive prenatal and postnatal care services.

5.2.2 Evaluation Mechanisms

Firstly, monitor compliance with maternity leave and flexible work arrangements through regular audits and employee satisfaction surveys; Secondly, evaluate the impact of career development and fertility support programs through longitudinal studies tracking participants' educational attainment, employment status, and fertility outcomes; Thirdly, assess the accessibility and quality of maternity insurance coverage through patient satisfaction surveys and healthcare utilization data analysis.

5.3 Reduce Parenting and Education Costs ^[12]

5.3.1 Implementation Details

Firstly, establish public-private partnerships to build and operate additional childcare facilities in underserved areas, with government subsidies for low-income families; Secondly, amend education laws to extend compulsory schooling to include pre-kindergarten and post-secondary education, with provisions for free or subsidized tuition and transportation; Thirdly, introduce tax credits and rebates for childcare expenses, educational materials, and housing costs for families with children.

5.3.2 Evaluation Mechanisms:

Firstly, monitor the availability and utilization of childcare facilities through regular inspections and surveys of parents and caregivers; Secondly, track school enrollment rates and dropout rates to assess the impact of extending compulsory education on educational attainment and retention; Thirdly, analyze tax records and household expenditure data to measure the financial impact of tax incentives and rebates on parenting and education costs.

5.4 AI-Driven Fertility Education Platform

An AI-driven fertility education platform utilizes artificial intelligence technologies to deliver personalized and accessible information about fertility, reproductive health, and family planning to individuals.

In the contemporary era of rapid technological advancement, leveraging AI for fertility education and support represents a promising approach to addressing the challenges of declining fertility willingness. By harnessing the power of AI algorithms, this platform can deliver personalized guidance and information to individuals considering family planning. Through interactive modules, virtual simulations, and AI-powered chatbots, users can access accurate and relevant information tailored to their specific needs and preferences. This not only enhances accessibility but also promotes informed decision-making and proactive engagement with reproductive health issues.

Equation (4) is the Reproductive Health Service Accessibility Index (RHSI). The concept of an accessibility index to quantitatively assess the availability and quality of reproductive health services across different regions.

$$RHSI = \frac{\sum_{i=1}^n (A_i \times Q_i)}{\sum_{i=1}^n P_i} \quad (4)$$

Where A_i , Q_i , and P_i are the availability of services, the quality of services, and is the population in area i .

Equation (5) represents Fertility Promotion Policy Impact Analysis. After outlining various policy interventions aimed at increasing fertility rates, regression analysis is used as a method to evaluate the effectiveness of these policies in achieving expected outcomes.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon \quad (5)$$

Where Y is the fertility rate, X_1, X_2, \dots, X_n are policy variables, $\beta_0, \beta_1, \dots, \beta_n$ are coefficients, and ε is the error term.

6 Conclusion

In order to cope with the slow economic development rate caused by aging population, China has introduced relevant policies to address the issue of declining birth rates, but the size of the population has not yet achieved effective growth. This article analyzes the main characteristics of the declining fertility willingness of contemporary age-appropriate marriage and childbirth

population from three aspects: the population size of eligible marriage and childbirth, education level, and the improvement of women's economic and social status based on AI technology. In addition, analyzing the reasons for the declining fertility willingness of the age-appropriate marriage and childbirth population from the changes in their marriage and childbirth concepts, reduced fertility, occupational risks, high parenting costs, and family income under the influence of AI. Finally, this article provides strategies to address the decline in fertility willingness, mainly discussing deepening education reform, strengthening and promoting reproductive health services and technologies, promoting a balance between women's careers and childbirth to increase population and further enhance economic development rates.

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