

Evolutionary Game of Fertility Desire of Women of Childbearing Age

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Abstract: In recent years, China's fertility rate has shown an obvious downward trend, which has aroused people's widespread concern. As social attitudes change, some women's concepts of childbearing also change and they don't want to have children too early. This paper constructs a game model between the government and women of childbearing age who don't want to have children and explores the effects of economic subsidies, psychological benefits, and job security brought by the government's policies to one-child or two-child families on the fertility desire. Through the study, it was found that current domestic fertility policies have not been effective in promoting higher fertility rates. The pure strategy Nash equilibrium obtained by the line drawing method is a strategy in which the government push fertility policies and women choose not to have children. In order to effectively increase the fertility rate, on the basis of increasing subsidies, the government should guide women who have not given birth to a correct view of fertility and provide women who have given birth to one child with more economic subsidies and employment guarantees.

Keywords: Evolutionary game, fertility desire, low fertility rate, government subsidies

1. Introduction

Data from the 2023 China Statistical Yearbook show that China's birth rate has been declining year by year in recent years, and in 2022 China's birth rate was only 6.77%, with the natural growth rate falling below 0% for the first time, to as low as -0.60% [1]. Data from the seventh population census show that the total fertility rate of women of childbearing age in China is about 1.3, which is below the replacement level of 2.1 [2]. While data from the fourth population census show a total fertility rate of 2.31 [3]. A sustained, regular decline in China's fertility rate would have multiple implications. For example, population aging, declining population, labor shortages, and social security will be under more pressure.

The Chinese government has gradually relaxed its strict family planning policies to promote fertility growth. In November 2013, after the Third Plenary Session of the 18th Central Committee of the Communist Party of China (CPC) considered and passed the Decision of the Central Committee of the Communist Party of China on several Major Issues Concerning the Comprehensive Deepening of Reforms, and the policy of "two-child alone" was proposed. In October 2015, the Fifth Plenary Session of the 18th CPC Central Committee explicitly pointed out that "the population development strategy should be improved, the policy of allowing one couple to have two children should be fully implemented, and actions to cope with the population aging should be actively carried out", and that

the "comprehensive two-child" policy was launched. In May 2021, the Political Bureau of the Central Committee considered and adopted the "three-child policy" and implemented complementary public support policies and measures. In July 2021, the Central Committee of the Communist Party of China and the State Council issued the Decision on Optimizing Fertility Policy to Promote the Long-term Balanced Development of Population (hereinafter referred to as the Decision). Supportive measures of the Decision include strengthening supportive policies such as taxation and housing, improving the employment rights and interests of women of childbearing age, and alleviating the burden of education and health care, which are aimed at providing better conditions for families that wish to have children. To stimulate the response to the national birth policy, some local governments implement some subsidies and incentives. Since July 2023, Beijing has included 16 therapeutic assisted reproductive technology programs in the outpatient Category A reimbursement scope of basic medical insurance [4]. The Shenyang Municipal Party Committee and Municipal Government issued the Implementation Plan for the Implementation of Positive Procreation Support Measures to Promote the Long-term Balanced Development of the Population, which largely safeguards the legitimate rights and interests of women who have given birth [5]. Some scholars have found, after statistics, that localities have continued to strengthen fertility support policies, and the population of strong second-tier cities such as Wuhan and Chengdu has increased rapidly [6].

The reduction in fertility is related to several factors, such as economic and social changes, as well as changes in family structures and social attitudes. This paper starts with a group of women of childbearing age. From the micro individual experience, with the increase in women's education level, women's views on family, marriage, and childbearing have changed, and they have become more focused on their individual career development, quality of life, and sense of well-being. After rationally evaluating the risks and benefits of marriage and childbearing, they chose not to have children or to have fewer children [7]. From the perspective of macro-social development, the impact of national economic development, technological progress, and the financialization of housing has brought existential anxiety to young people, especially women. Not having children or having fewer children has become a passive resistance strategy for women in response to the enormous external social pressures [7]. Therefore, the relationship between government fertility policies and the fertility desire of women of childbearing age is very important. This paper adopts the evolutionary game theory to analyze this process and explore the impact of economic subsidies, psychological benefits, employment security, and other factors on the fertility desire of women of childbearing age. This paper will analyze the direction and different focus of government support needed to encourage the birth of one child and the common need for two children.

2. Manuscript Preparation

One interpretation of fertility desire in national studies is as follows: fertility desire is people's thoughts, attitudes, and expectations about reproductive behavior and outcomes. It is affected by factors such as national fertility policy, social economy, political culture, one's family situation, personal social concepts, etc [8].

Reviewing the literature, this paper found that research on the impact of different factors on fertility desire can be divided into two categories. One is structural factors, such as economy, culture, religion, region, and policy. The other type is demographic factors, such as education, income, age, health status, marital relationship, occupation and values, etc [9]. Many scholars have studied the impact of national fertility policies on fertility desire. For example, Jinying Wang and Fei Zhang reviewed the practical experience of public policies in response to low fertility rates. Then they came up with the idea of restraining the "source" of childlessness while "stimulating" and "supporting" individual fertility needs [10]. By analyzing the fertility trend under the fertility policy, Baochang Gu believes that the postponement effect among young people is very strong while the compensation

effect among older people is very weak [11]. These papers all point to the current state of fertility in China: although my country's fertility policy has been loosened year by year and measures such as incentives, subsidies, and guarantees have been added, the incentive effect of the fertility policy is still not as good as expected.

To summarize, a relatively complete body of knowledge has been established by academics on the relationship between the fertility desire of women of childbearing age and fertility policies. However, the research is done by analyzing the existing data, discussing the current policies, or surveying the public. Among the existing domestic studies, some have also constructed a game model on fertility decision-making between the government and women of childbearing age. They analyze the equilibrium of the model and make specific policy recommendations for certain influences [12,13]. On this basis, this paper will highlight the role of the local government's fertility policy through the method of game theory, and analyze the one-child and two-child families separately. This paper will construct a game matrix between local government and women of childbearing age, and explores the impact of economic subsidies, psychological benefits, employment security and other factors brought by government policies to families with one or two children on women of childbearing age's fertility desire.

Domestic scholars generally divide women of childbearing age into three groups: those who are unmarried, infertile or have few children are called the group that does not want to have children. Those who can give birth but dare not, cannot afford to give birth, or cannot afford to raise children are called the group that dare not give birth. Those who cannot have children due to objective reasons are called the infertile group. This article mainly focuses on the discussion of the group that does not want to have children.

There are many reasons why women of childbearing age do not want to have children. This article mainly analyzes the three aspects of economy, social development, and culture. From an economic point of view, research data shows that among the subjective reasons that affect people's fertility desire, the first is the cost of having children. Peiwen Liu's research finds that the rise in housing prices has caused young people to bear high mortgage loans to buy a house. Young people are afraid to take financial risks, which leads to a decrease in fertility desire. In addition, giving birth to a second or third child often requires planning to buy a larger house, increasing the financial burden on young people [14]. From the point of view of social development, the decrease in fertility rate is accompanied by a substantial increase in the relative education level of women [15]. Therefore, more and more women pay more attention to personal development, of which career development is a very important part. The existence of fertility penalties in the labor market and the fierce market competition make the labor force inevitably consider the cost of fertility when making fertility decisions [16]. From the point of view of culture, the post-70s generation's views on childbirth are "raising children for old age" and "carrying on the family line." The post-80s generation begins to take personal happiness as its goal, and the post-90s generation pays more attention to the happy experience and reproductive value during childbirth. In this culture, young people seek a balance between family and self-worth by delaying their childbearing plans and reducing the number of children [17]. Therefore, the parameter settings for women of childbearing age can be summarized as the psychological cost of giving birth, raising and educating a child, the economic cost of giving birth, raising and educating a child, and the cost of employment losses due to childbirth.

The National Maternity Policy also proposes measures to deal with the above three aspects. In the Decision, the economic support measures can be summarized as follows: (1) Improve the maternity leave and maternity insurance system. (2) Strengthen taxation, housing, and other supporting policies. (3) Promote educational equity and the supply of high-quality educational resources. Support measures for women's employment ensure women's legitimate rights and interests in employment. In terms of culture, changes in the concept of fertility should be "softly constrained" from the social

aspects, and the education and propaganda of the culture of childbirth should be actively carried out. Let the younger generation realize the importance of reproductive behavior to the family and that reproduction is an important way to realize their life value [10]. The Decision also mentioned that should do a good job in publicity and guidance, promote age-appropriate marriage and childbearing, eugenics and eugenics, and encourage couples to share childcare responsibilities. Further, the local government responds to the call of the state and actively promotes the fertility policy to bring better subsidy policy to the local people. Therefore, the benefits brought by the local government to women of childbearing age can be summarized as the psychological benefits from changes in fertility concepts caused by government propaganda, the economic subsidies provided by the government that exceed the policy, and the subsidies provided to protect the legitimate rights and interests of women in employment.

3. Construction and Analysis of Game Models

3.1. Basic Assumptions

The situation considered in this article is that married women of childbearing age are in stable jobs. They have not given birth or have one child, and are considering whether to have children under the national fertility policy and the local government's maternity subsidy policy. To facilitate the construction of the model, this article believes that government propaganda, economic subsidies, and measures to ensure female employment are implemented together, and that government propaganda encourages the birth of one child and two children at the same time. After the government's propaganda, women of childbearing age who choose to have children can receive more "the psychological benefits from changes in fertility concepts caused by government propaganda". However, women of childbearing age who have not chosen to have children indicate that their fertility concepts have not completely changed, so they have received fewer "psychological benefits from changes in fertility concepts caused by government propaganda".

3.1.1. Earnings for Women of Childbearing Age

As shown in table 1, the parameters of the family are family fixed income, the psychological cost of giving birth, raising and educating a child, the economic cost of giving birth, raising and educating a child and the cost of employment losses due to childbirth. The parameters of the fertility policy are fixed income from national fertility policy. The earnings brought by the government are the psychological benefits from changes in fertility concepts caused by government propaganda, the economic subsidies provided by the government that exceed the policy and the subsidies to protect the legitimate rights and interests of women in employment. Among them, the parameters A, B, D, M, and N of the one-child and two-child families are different in size, so two parameters are set. Furthermore, the psychological benefits from changes in fertility concepts caused by government propaganda has two different situations, so set F and f, and $F > f$.

Table 1: Earnings for women of childbearing age.

		Birth of one children	Birth of two children
Family	Family fixed income	A	A'
	The psychological cost of giving birth, raising and educating a child	B	B'
	The economic cost of giving birth, raising and educating a child	C	
	The cost of employment losses due to childbirth	D	D'
Fertility policy	Fixed income from national fertility policy	E	
Governments	The psychological benefits from changes in fertility concepts caused by government propaganda	F/f(F>f)	
	The economic subsidies provided by the government that exceed the policy	M	M'
	The subsidies to protect the legitimate rights and interests of women in employment	N	N'

3.1.2. Gains to the Government

Table 2: Gains to the government.

The cost to the Government of promoting a range of measures	G
Government unit gains/losses from fertility changes	H
Correlation function for the transformation of earnings of women of childbearing age into changes in fertility rates	g

As shown in table 2, first, the parameters of government revenue is the cost to the Government of promoting a range of measures. In order to be express the impact of changes in the fertility desire of women of childbearing age on the government, this article sets parameters correlation function for

the transformation of earnings of women of childbearing age into changes in fertility rates and government unit gains/losses from fertility changes.

3.2. Game Model Between Women of Childbearing Age and the Government

Women of childbearing age have a strategy set of (childbearing, no childbearing) and the government has a strategy set of (push, no push). There will be four different combinations of strategies in the game (childbearing, push), (childbearing, no push), (no childbearing, push) ,(no childbearing, no push). The government acts first, and women of childbearing age act second.

Table 3: The game matrix for women of childbearing age who have not given birth.

		Government	
		Push	No push
Women of childbearing age who have not given birth	Childbearing	$(A-B-C-D+E+F+M+N, g(A-B-C-D+E+F+M+N)H-G)$	$(A-B-C-D+E, g(A-B-C-D+E)H)$
	No childbearing	$(A+f, g(A+f)H-G)$	$(A, g(A)H)$

As shown in table 3, in this game model, the government will choose not to push to reduce the current loss when women of childbearing age choose the strategy of not having children. However, in the long run, as the fertility rate decreases, H will become larger, causing the government to lose too much money. So the government will choose to promote the decision to slow down the decline of the fertility rate. When women of childbearing age choose a fertility strategy, it is obvious that continuing to promote fertility policies can achieve a win-win situation for women of childbearing age and the government. Through the line-drawing method, it can be seen that the government will choose a strategy to push fertility policies whether women of childbearing age are having children or not. This is also in line with the actual situation. Under the requirements of national policies, the government will push the fertility policy.

Women of childbearing age who do not have children, are subject to the government's choice of "push" strategies. The cost of C is significant. The economic cost of having a child and educating and raising a child to the point where he or she can support himself or herself is greater than the economic subsidies provided by the government, i.e., $C > (E + M)$. Data from the Third Survey on the Social Status of Chinese Women show that 20.2% of working women have experienced career interruptions of more than half a year due to marriage and childbirth or childcare [18]. It can be inferred from this that the current female employment protection measures are not perfect enough, so $D > (E+N)$. The psychological cost of giving birth, raising, and educating a child is long-term and deepening. As the individual awareness of the younger generation continues to strengthen, they are unwilling to sacrifice individual happiness and birth experience for the so-called traditional values such as "carrying on the family line" and "continuing the incense". It can be obtained that the education and publicity guidance for reproductive culture has not been deeply rooted in people's minds, so $B > F$. By comparison, it can

be concluded that $(A-B-C-D+E+F+M+N) < (A+f)$ under the strategy that the government chooses to push. Through the line-drawing method, women of childbearing age will choose the strategy of not childbearing.

In the game matrix in Table 4, the pure strategy Nash equilibrium obtained by the line-drawing method is (no childbearing, push).

Table 4: The game matrix for women of childbearing age who have already had one child.

		Government	
		Push	No push
Women of childbearing age who have given birth to one child	Childbearing	$(A'-B'-C-D'+E+F+M'+N', g(A'-B'-C-D'+E+F+M'+N')H-G)$	$(A'-B'-C-D'+E, g(A'-B'-C-D'+E)H)$
	No childbearing	$(A'+f, g(A'+f)H-G)$	$(A', g(A')H)$

As shown in table 4, since one-child families will face greater economic pressure than families without children, this article assumes $A' < A$. At the same time, the psychological pressure of having two children must be greater than the pressure of having one child, so it is assumed that $B' > B$. In terms of employment, the second childbirth requires more time costs. It is not enough for women to compress their leisure time. So this will affect working hours. Therefore, the second childbirth has a stronger impact on women's employment [19]. Moreover, the birth of two children increases the cost of employing women in enterprises, and some enterprises will reduce the recruitment of female employees to protect their interests. This increases the discrimination against women [20], so $D' > D$. In the same way, $(A'-B'-C-D+E+F+M'+N') < (A'+f)$. Through the line-drawing method, women of childbearing age who have given birth to one child will choose the strategy of not childbearing.

In the game matrix in Table 4, the pure strategy Nash equilibrium obtained by the line drawing method is (no childbearing, push).

This paper compares the (childbearing, push) strategy combinations in Table 3 and Table 4. From the above analysis, $B' > B$, $D' > D$, it can be concluded that $(B+C+D) < (B'+C+D)$, that is, the cost of having one child for women of childbearing age is greater than the cost of having a second child. M , M' , N , N' are discussed below. Assume that the government has the same subsidy policy for first and second children, that is, $M=M'$, $N=N'$. And because $(A-B-D) > (A'-B'-D')$, it has $(A-B-C-D+E+F+M+N) > (A'-B'-C-D'+E+F+M'+N')$. In this case, although the government's subsidy is the same for each child, it does not take into account the family's comprehensive situation. The government does not provide sufficient subsidies to families having a second child, which will reduce the incentive effect for women of childbearing age who have already given birth to a second child to have a second child. In order to increase the gain from childbearing for women of childbearing age who have already had one child, increasing F remains $(A-B-C-D+E+F+M+N) > (A'-B'-C-D'+E+F+M'+N')$. The effect of increasing F on increasing fertility intentions was not significant.

Therefore, this paper should start by increasing M' and N', so that the inequality becomes $(A-B-C-D+E+F+M+N) \leq (A'-B'-C'-D'+E+F+M'+N')$, can effectively encourage the birth of a second child.

4. Discussion

4.1. Improvement of the Economic Subsidy Policy to Reduce the Financial Burden of Childbearing Families

The first is to provide free or low-cost medical services. The government can build more public medical institutions or expand the coverage of basic medical insurance to reduce the medical expenses of childbearing families, especially the medical expenses during childbirth and pregnancy. What is more, the government can establish and improve the health insurance system to ensure broad coverage and provide financial subsidies for low-income people.

The second is to promote educational equity and the supply of high-quality educational resources. The State should develop fair admissions policies to ensure that every student has equal access to education and avoid basing enrollment on economic status or other non-academic factors. The Government should increase its investment in basic education and ensure a balanced distribution of school facilities, teachers, and educational resources. Particularly in impoverished areas, resources should be increased to narrow the education gap between urban and rural areas and between regions.

The third is to increase housing subsidies. Provide more favorable housing loan interest rates or loan subsidies for families with children to reduce the pressure of home buying. The government can set up special institutions to provide loan support to families having children. Furthermore, the government can set up a housing subsidy program to provide a certain amount of housing subsidies to families that meet the conditions of the maternity policy and help them purchase or rent suitable housing more easily. For families with two children, the amount of housing subsidies can be appropriately increased.

The fourth is to reduce taxes on families having children. The government can prioritize the reduction of personal or family income tax for working women who are mothers and attach a special deduction for personal or family income tax. For families with two children, a differentiated tax deduction policy can be implemented. It means that the more children a family has, the higher the tax refund rate and the greater the tax refund amount that an individual or family can enjoy.

4.2. Create A Good Employment Environment and Protect Women's Legitimate Rights and Interests in Employment

The first is to provide reasonable childcare leave and flexible working hour arrangements. Enterprises can offer paid and unpaid childcare leave and decide on the length of vacation according to the needs of employees and the situation of the company. For two-child families who need more time to take care of their children, a flexible working hour system is implemented to allow employees to freely choose their working hours within a certain range of working hours. For two-child families who need more time to take care of their children, a flexible working hour system is implemented to allow employees to freely choose their working hours within a certain range of working hours. This helps employees to better organize their work and family life and reduce conflicts between work and family responsibilities.

The second is to formulate clear anti-gender discrimination policies. Enterprises should ensure that all employees are aware of these policies. The policy should cover hiring, promotion, compensation, training, etc. to clarify the company's zero-tolerance stance on gender discrimination. Enterprises should also establish independent complaint channels to enable female employees to anonymously report corporate violations of maternity protection regulations. At the same time, enterprises should ensure the protection of whistleblowers to prevent retaliation.

The third is to increase supervision and punishment of Enterprises dismissing women who have given birth. Relevant departments should ensure that labor laws and employment regulations are effectively implemented, including increasing regular inspections, and irregular spot inspections and effectively punishing companies that violate regulations. The amount of fines imposed on enterprises that violate regulations should be increased to more effectively punish violations. Enterprises that fire women who have given birth to a second child need to be strictly monitored and fined more.

4.3. Promote the Correct View of Fertility and Correct the Misunderstanding of Responsibility for Reproductive Behavior

The government's emphasis on education and publicity on childbearing is crucial to shaping positive perceptions of childbearing and reducing negative orientations. The government should actively explore the positive fertility values in traditional culture, emphasize the importance of family, the value of children's education, etc., and enhance people's positive perception of fertility by promoting positive factors in traditional culture. The community carries out comprehensive fertility education, and formulates and promotes comprehensive fertility education plans, covering reproductive health, family planning, parenting skills, and other aspects. Let young people realize that children are an important part of the family and have a positive impact on the healthy and harmonious development of the family, changing the idea of "not giving birth" to the idea of "giving birth".

5. Conclusions

Through the game matrix between women of childbearing age who have not given birth or women of childbearing age who have given birth to one child and the government, it can be seen that the current fertility policy has not effectively promoted the increase in fertility rate. Women of childbearing age tend to delay childbearing and control the number of children they have to enhance their value and pursue a happy life. Based on the strategy of childbearing among women of childbearing age, the government has to choose a strategy to push fertility policies to respond to the national call and slow down the decline in fertility rates. The pure strategy Nash equilibrium of both game matrices is childbearing. For women of childbearing age who have not given birth, the focus that needs to be strengthened is F. The government is to promote the correct concept of childbearing and guide the reproductive behavior of young people. For women of childbearing age who have already had one child, the economic and employment burdens of having a second child are much greater than those of having a child, so the focus needs to be strengthened as M', N'.

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