How Does Digital Life Affect Family Fertility Behavior? — An Analysis Based on CFPS Data of Chinese Families with a Second Child

yinkai liao
Hunan University
nengsheng luo
Hunan University
xiaohan yan
yanxiaohan97@outlook.com

Hunan University

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Abstract: This paper uses data from the 2014–2020 China Family Panel Studies (CFPS) and draws on Becker's household production theory to examine the impact of digital life on second-child fertility behavior. The results show that digital life has a significant negative effect on second-child fertility: households with higher levels of digital engagement are less likely to have a second child. Digital life influences fertility mainly through three channels: time displacement, parenting pressure, and changes in parenting attitudes. Among different dimensions of digital life, digital learning, work, and entertainment exert a stronger negative impact on fertility than digital consumption. The negative effect of digital life is more pronounced after the implementation of the universal two-child policy, in urban households, in higher-income families, and in families whose first child is a boy. Moreover, the crowding-out effect of healthcare coverage and the rising cost of childrearing further strengthen this negative impact. However, modern parenting attitudes and grandparental childcare support can partially mitigate this adverse effect. Based on these findings, this paper proposes a series of policy recommendations aimed at improving digital life management and optimizing household fertility behavior.

Keywords: Digital Life; Second-Child Fertility; China Family Panel Studies (CFPS);

1. Introduction

Fertility rates have experienced a notable global decline in recent decades, with the trend being particularly pronounced in developed and emerging economies. Data from the United Nations Population Fund (UNFPA) indicate that the global total fertility rate declined from 5.0 in the 1960s to 2.4 in 2020. In many developed and middle-income countries, fertility rates have dropped below replacement levels, leading to the so-called 'low fertility trap' (United Nations, 2022). For example, total fertility rates in Japan, South Korea, and Italy have fallen to below 1.3. This persistent trend of low fertility has significant repercussions for socioeconomic development and labor market dynamics.

The rapid advancement of digital and information technology, particularly the widespread adoption of the internet and smartphones, has deeply integrated into various aspects of family life. It has reshaped work patterns, social interactions, information access, and entertainment consumption (Anderson B & Tracey K, 2002)[1]. Digital life encompasses the use of the internet and related technologies to address everyday needs, such as social interactions, online shopping, remote work, and online learning.As digitalization progresses, family lifestyles and time management have undergone substantial changes. These shifts are especially evident in fertility decisions, where the role of digital life in shaping choices has grown significantly (Bernardi L et al, 2014)[2].

In China, the relaxation of the two-child policy has reshaped the socio-economic factors driving family fertility decisions (Zeng Y & Hesketh T, 2016)[3]. The widespread adoption of digital technologies has made it easier for families to obtain information on parenting, education, healthcare, and policies, while also transforming how family members interact with one another.In an era of information overload, the internet offers families extensive resources but also introduces considerable stress and anxiety, particularly regarding parenting costs, time management, and career progression (Zhang C et al., 2022)[4]. Digital life intensity and awareness have emerged as key

determinants in families' second-child decisions.

Existing studies on family fertility decisions highlight a variety of influencing factors. At the macro level, elements such as housing prices, regional economic development, inequality, and urbanization play significant roles in shaping fertility behaviors (Chu M & Chang Y, 2022; Hu P & Wang H, 2020; Yu J et al., 2021; Ni G & Cai F, 2015)[5][6][7][8]. At the micro level, fertility choices vary significantly across individuals of different ages and health conditions. The quality of marital relationships directly impacts family fertility decisions, as does support from older generations, household wealth accumulation, income levels, and the comprehensiveness of social security systems. These factors influence both the economic and opportunity costs of childbearing, ultimately determining whether families are willing to have more children (Willis, 1973; Adsera, 2004; Yang J, 2011; Wang T & Peng X, 2015; Brinton & Lee, 2016; Feng J et al., 2020)[9][10][11][12][13][14].

The relationship between digital life and fertility decisions has garnered attention, with scholars presenting differing views. Some studies argue that digital life promotes family fertility. For instance, Qiu L et al. (2022) used CFPS data and found that internet usage decreases fertility intentions[15]. Xie Y and Guo J et al. (2024), using a double machine learning (DML) approach, analyzed the effects of digital financial inclusion on fertility. Their findings indicate a slight positive impact of digital financial inclusion on fertility rates, as it lowers the opportunity cost of childbearing and encourages families to have more children[16]. Similarly, Stenström K (2022) highlighted the unique role of digital media in supporting women facing infertility. Through blogs and Instagram, women documented their fertility treatment journeys, reshaped the meaning of unborn children, and built mutual support networks in digital spaces. This digital fertility narrative not only filled a gap in societal discourse but also conferred symbolic meaning to unfulfilled fertility goals[17]. Billari et al. (2019) used data from Germany and found that the proliferation of the internet increased the proportion of women working part-time from home, positively impacting fertility[18]. Additionally, Yousef H and Al-Sheyab N et al. (2021) explored the potential of digital technologies, such as mobile apps and online platforms, in enhancing family planning services for Jordanian communities and Syrian refugee women. Their research suggests that digital tools improve access to fertility information, reduce knowledge gaps, and empower women in fertility decision-making[19].

On the other hand, some scholars argue that digital life suppresses family fertility. Du W and Mao Y (2023) attributed this reduction to two mechanisms: time displacement and opportunity cost[20]. Wang X et al. (2021) observed a negative correlation between internet usage frequency and fertility intentions, attributing this to increased information costs and changes in intergenerational dynamics within families[21]. Huang Y (2024) argued that the internet shapes women's fertility attitudes through diverse information channels, virtual social interactions, and online discussions, which often lead to lower fertility intentions[22]. Zhang J and Jamil R (2024) examined the interplay between China's fertility policy adjustments and women's employment dynamics in the context of digital HRM technologies. Their findings suggest that while policy adjustments aim to help women balance family and work, the rapid development of digital technologies disrupts traditional employment structures, particularly affecting low-skilled women[23]. Nie P and Peng X et al. (2023) showed that internet usage significantly lowers fertility rates among Chinese women of childbearing age, with rural, married, and moderately educated women being most affected. Mechanisms include changes in marital satisfaction, gender norms, and health deterioration[24]. Adaki A Y (2023) investigated the role of digital technologies such as

mobile apps, online platforms, and telemedicine in shaping women's family planning attitudes. Digital tools provided reliable information on contraceptive methods and helped women better plan their fertility timing[25]. Liu P et al. (2021) analyzed the relationship between internet usage frequency, fertility intentions, and traditional gender role attitudes among 3,113 Chinese women using CGSS2017 data. Their findings indicate that internet adoption reshapes traditional gender norms, lowering fertility intentions. The study underscores the need to consider cultural and ideological shifts driven by the internet when addressing fertility issues[26]. Wang Xiaojie et al. (2021) argue from the perspective of information costs and intergenerational family dynamics that individuals who use the internet and those with higher internet usage frequency have lower fertility intentions[27].

Through a review of existing literature, studies on digital life and fertility have predominantly examined internet usage and its influence on fertility intentions. However, digital life extends beyond internet usage, encompassing learning, work, entertainment, and consumption, all of which may have varying impacts on fertility. Furthermore, most research prioritizes fertility intentions over actual fertility behaviors, with limited attention to the specific issue of second-child fertility in the unique context of China. Finally, fertility decisions are typically made at the family level, whereas most studies focus on individuals as the unit of analysis.

This study takes families as the unit of analysis to explore how digital life influences second-child fertility behaviors. The potential innovations of this research are as follows: First, it examines digital life from the perspectives of learning, work, entertainment, and consumption, offering a more comprehensive and detailed analysis. Second, taking families as the unit of analysis overcomes the limitations of individual-based research, making the study of second-child fertility behaviors more realistic and the findings more practically relevant. Third, this study integrates digital life into fertility decision-making models as a modern influencing factor, exploring how it affects fertility behaviors by altering individual and family lifestyles and resource allocation, thereby enriching and expanding existing theoretical frameworks. Fourth, it further investigates the moderating mechanisms through which related factors influence the impact of digital life on family fertility behaviors, offering concrete and broader insights into how to regulate and optimize fertility behaviors in the context of digital life.

2.Theoretical Analysis

2.1Analysis Based on Becker's Family Production Model

This study is based on Becker's (1965, 1973) family production theory, which suggests that families decide on time allocation and childbearing under the principle of utility maximization[28][29]. The model assumes that families allocate limited resources between the quantity (n) and quality (q) of children. A utility function is constructed, where utility (U) is determined by the number of children (n), their quality (q), and the parents' digital life level (D). The function can be expressed as:

$$U = U(n, q, D) \qquad (2-1)$$

In this model, n represents the number of children in the family, where n=2 corresponds to second-child fertility. q denotes the quality of children, reflecting family investments in education, health, and living standards. D captures the digital life level of the family or parents, encompassing factors such as internet usage time and the frequency of participation in digital activities. From an economic perspective, this utility function reflects not only the traditional "quantity–quality" trade-

off but also incorporates digital life into family decision-making. On the one hand, digital life may bring convenience. For example, online education and telemedicine can reduce information costs and improve access to essential services. On the other hand, it may increase resource consumption, such as time spent on digital entertainment or unnecessary online spending. In practice, as digitalization in China continues to deepen, digital life has become an important factor influencing family fertility decisions. When deciding whether to have a second child, families now consider not only income and child-rearing costs but also the convenience and pressures associated with digital tools.

To analyze how digital life affects second-child fertility decisions, it is essential to consider the resource constraints faced by households. In addition to preferences over the number and quality of children, fertility choices are fundamentally shaped by the limits of household income. Digital life directly interacts with this constraint by creating new forms of expenditure while also offering potential cost-saving benefits. Therefore, it is necessary to explicitly model the household budget constraint.

The household budget constraint can be expressed as:

$$Y = C(n, q) + G(D) - S(D) \qquad (2-2)$$

Here, Y represents household income; $C(n, q)$ denotes the cost of raising children, which increases with both the number n and the quality q of children; $G(D)$ refers to the expenditures associated with digital life, such as the cost of devices, internet access, and paid digital services; and $S(D)$ captures the cost-saving effects of digital tools, such as reduced expenses from online education or telemedicine.

Taking the partial derivative of digital life D, the economic cost effect of digital life can be obtained:

$$\frac{\partial \text{ cost}}{\partial D} = \frac{\partial G}{\partial D} - \frac{\partial S}{\partial D} \qquad (2-3)$$

When $\frac{\partial G}{\partial D} > \frac{\partial S}{\partial D}$, digital life exhibits a "cost-increasing effect," meaning that digital expenses (such as paid education or device purchases) outweigh the cost-saving benefits. This squeezes the household budget for child-rearing and reduces the likelihood of having a second child. In contrast, when $\frac{\partial G}{\partial D} < \frac{\partial S}{\partial D}$, the cost-saving effect of digital tools dominates, freeing up more economic resources for childcare and thereby alleviating fertility constraints. In practice, households with higher levels of digital literacy and stronger purchasing power are better able to use digital tools to reduce education and healthcare costs, making them more likely to satisfy the condition $\frac{\partial G}{\partial D} < \frac{\partial S}{\partial D}$. Conversely, households with lower digital literacy often face high digital device and service expenses, tend to fall under the condition $\frac{\partial G}{\partial D} > \frac{\partial S}{\partial D}$, and consequently see their ability to have a second child further weakened.

The household's time constraint can be expressed as follows. Assume that the total available time for a household is T, which must be allocated among working time T_W, parenting time T_p, and time spent on digital life T_D:

$$T = T^w + T^p(n, q) + T^d(D) - E(D) \qquad (2-4)$$

Here, T represents the total available time of the household; T^w is the time spent on work;

$T^p(n,q)$ is the time required for parenting, which depends on the number and quality of children; $T^d(D)$ is the time consumed by digital life, such as overtime work and digital entertainment; and $E(D)$ is the time saved through digital life, including the use of smart home devices, online government services, and remote work, which reduce the time spent on household and administrative tasks.

Taking the partial derivative of digital life D, the time cost effect of digital life can be expressed as:

$$\frac{\partial \text{ Time}}{\partial D} = \frac{\partial T^d}{\partial D} - \frac{\partial E}{\partial D} \quad (2-5)$$

When $\frac{\partial T^d}{\partial D} > \frac{\partial E}{\partial D}$, digital life generates a "time displacement effect." In this case, digital activities occupy a substantial amount of time, reducing parents' interaction and childcare time, thereby discouraging second-child fertility. In contrast, when $\frac{\partial T^d}{\partial D} < \frac{\partial E}{\partial D}$, digital life saves time, alleviates childcare conflicts, and lowers the time-related opportunity cost of having a second child. In practice, this effect varies significantly across families: in high-pressure urban environments, parents' digital overtime and entertainment activities are more likely to create time displacement, while in families with grandparental support or efficient use of digital tools, the time-saving effect often dominates and helps reduce fertility pressure.

Combining the budget and time constraints, the household's utility maximization problem can be expressed using the Lagrangian function:

$$\mathcal{L} = U(n,q,D) + \lambda[Y - C(n,q) - G(D) + S(D)] + \mu[T - T^w - T^p(n,q) - T^d(D) + E(D)] \quad (2-6)$$

Here, λrepresents the shadow price of the budget constraint, reflecting the marginal utility of income, while μ denotes the shadow price of the time constraint, capturing the marginal utility of time resources. This formulation shows how households maximize utility by balancing child quantity, child quality, and digital life under income and time limitations.

Taking the first-order condition with respect to digital life D:

$$\frac{\partial U}{\partial D} = \lambda\left[\frac{\partial G}{\partial D} - \frac{\partial S}{\partial D}\right] + \mu\left[\frac{\partial T^d}{\partial D} - \frac{\partial E}{\partial D}\right] \quad (2-7)$$

This condition indicates that the marginal utility of digital life is determined by two components: the net economic cost effect, represented by $\lambda\left[\frac{\partial G}{\partial D} - \frac{\partial S}{\partial D}\right]$, and the net time cost effect, represented by $\mu\left[\frac{\partial T^d}{\partial D} - \frac{\partial E}{\partial D}\right]$. The sign and magnitude of these two effects jointly determine whether digital life inhibits or facilitates second-child fertility.

This theoretical framework not only reveals the economic and time mechanisms through which digital life operates but also provides a solid mathematical foundation for subsequent mechanism testing. In the next step, this paper will conduct empirical tests based on three specific paths—time displacement, parenting pressure, and parenting attitudes—to verify the concrete mechanisms through which digital life influences second-child fertility behavior.

2.2Analysis of the Mechanisms of Influence

Based on the extended Becker household production model, the impact of digital life on the

decision to have a second child is conditional and bidirectional. When $\lambda\left[\frac{\partial G}{\partial D}-\frac{\partial S}{\partial D}\right]+\mu\left[\frac{\partial T^{d}}{\partial D}-\frac{\partial E}{\partial D}\right]>0$, digital life mainly increases both economic and time costs. In this case, it exerts a "double squeeze" effect and significantly suppresses the likelihood of having a second child. However, when digital tools reduce costs or save time, this negative effect can be weakened or even partially reversed. Therefore, the influence of digital life is context-dependent. To further clarify this relationship, we examine three potential mechanisms: time displacement, parenting pressure, and parenting attitudes.

First, time displacement is a key channel through which digital life affects second-child fertility. When digital life mainly occupies time, parents spend many hours on online work, entertainment, or browsing information(Guryan et al., 2008; Kreyenfeld & Zeman, 2017)[30][31]. This reduces the time available for childcare, intensifies time constraints, and raises the opportunity cost of having a second child. Families often respond by limiting the number of children to maintain their quality of life. This situation is particularly common among dual-earner families in large cities, where long working hours and digital office tools leave parents with little time for childcare, discouraging second-child fertility. By contrast, when digital tools improve time efficiency, digital life may instead have a positive effect. Smart home devices, online education, and remote work can reduce time spent on housework and tutoring. This helps parents manage their time more effectively and creates more favorable conditions for a second child. For example, in families with grandparental support, digital tools and family time-sharing can work together to ease time constraints, making the decision to have a second child more feasible.

Second, digital life affects second-child fertility through parenting pressure. When $\frac{\partial G}{\partial D}>\frac{\partial S}{\partial D}$, digital life raises household spending on education, healthcare, and related services. This strengthens the economic burden on families and discourages them from having a second child. For instance, urban families that invest heavily in online courses or digital learning materials often face substantial financial pressure, which crowds out the resources needed for a second child. On the other hand, when digital life lowers child-rearing costs, it can reduce financial stress and support second-child fertility. Remote medical services can cut travel and consultation expenses, while online education can substitute for costly offline tutoring, thereby releasing household budget resources for raising an additional child.

Finally, digital life may influence second-child fertility through changes in parenting attitudes. In a highly digitalized environment, families are exposed to modern parenting values that may weaken traditional views such as "raising children for old-age support." Research by Pan Sitong and Shi Qinghua (2023) indicates that traditional views of fertility, such as "raising children for old age support," are shifting[32]. As a result, many families—especially those with higher education levels in urban areas—shift toward prioritizing personal development and quality of life, which reduces their preference for having a second child. At the same time, digital life can also strengthen modern parenting values that emphasize emotional satisfaction and family completeness. Social media and online parenting communities often increase parents' emotional engagement in childcare, and some families may view a second child as a way to enhance family happiness. Under such circumstances, digital life may partially offset its negative effect on fertility.

In summary, digital life affects second-child fertility through time displacement, parenting

pressure, and parenting attitudes, and each of these mechanisms has both negative and positive effects. In resource-constrained families, the negative effects dominate. In contrast, in families with stronger resource buffers—such as grandparental childcare support or efficient use of digital tools—these negative effects may be reduced or even reversed. The following empirical analysis will test these mechanisms and provide evidence for the conditional impact of digital life on second-child fertility. This also lays the groundwork for the subsequent analysis of moderating factors.

3. Research Design

3.1 Sample and Data Sources

This study uses data from the China Family Panel Studies (CFPS), a nationally representative longitudinal survey covering socioeconomic status, education, health, and other key variables of Chinese households. To ensure completeness and accurately capture family decision-making, the sample includes households with both spouses participating in the survey, already having one child, and under 35 years old and of childbearing age. The study utilizes CFPS data from 2014, 2016, 2018, and 2020, capturing the period surrounding the implementation of China's 'universal two-child policy' and enabling analysis of the policy's impact on fertility decisions.

3.2 Model Construction

As the decision to have a second child is represented as a binary variable, and to incorporate the time dimension and variations across individual families, given the availability of a large dataset, this study employs a random-effects Logit model. This approach not only explains family behavior in the sample but also enables broader generalization to households nationwide. The model is constructed as follows:

$$logit\left(P\left(y_{\{it\}} = 1\right)\right) = \alpha + \beta 1 * X_{\{1it\}} + \beta 2 * X_{\{2it\}} + \ldots + \beta k * X_{\{kit\}} + u_i \quad (3-1)$$

$y_{\{it\}}$ represents the second-child fertility decision of the i-th household in period t (1 indicates having a second child, and 0 indicates not having a second child). $P\left(y_{\{it\}} = 1\right)$ is the probability that the i-th household decides to have a second child in period t. $logit\left(P\left(y_{\{it\}} = 1\right)\right)$ represents the log-odds of having a second child. α is the constant term (intercept) of the model. $X_{\{1it\}}, X_{\{1it\}}, \ldots X_{\{kit\}}$ are the independent variables for the i-th household in period t (e.g., digital life, income, etc.), and $\beta 1, \beta 2, \ldots \beta k$ are the corresponding regression coefficients. u_i is the random effect for the i-th household, reflecting unobservable heterogeneity between households. The random effect u_i is assumed to follow a normal distribution:

$$u_i \sim N(0, \sigma_u \text{^} 2)$$

Here, $\sigma_u$represents the standard deviation of the random effects.

3.3 Explanatory Variables

Digital Life: This variable measures the frequency of internet use by both spouses in activities such as work, learning, entertainment, and consumption. It reflects the breadth and depth of digital activities in the daily lives of family members.

3.4 Dependent Variable

Whether the family has a second child: This variable reflects whether a family chooses to have a second child at a specific point in time. A value of 1 indicates that the family has had a second child at that time, while a value of 0 indicates that the family has not.

3.5 Control Variables

Life Satisfaction: Represents a family's assessment of their current living conditions, including economic status, family dynamics, and work-life balance. Families with higher life satisfaction may prefer to maintain the status quo or consider having more children if financially stable, while families with lower life satisfaction may approach the decision more cautiously.

Household Income: Indicates the financial capacity of the family. Higher income levels provide economic security for raising additional children, alleviating the financial burden of parenting. In contrast, lower income may intensify economic pressure, discouraging further fertility.

Household Social Status: Reflects a family's social resources, reputation, and capital. Families with higher social status may plan differently due to increased social expectations and a focus on family structure, while those with lower social status may adopt a more conservative stance due to resource limitations.

Evaluation of Local Government: Trust and satisfaction with local government may shape a family's confidence in future public services, including education, healthcare, and social security. Families with positive evaluations may feel secure in raising children locally, while those with negative evaluations may prefer fewer or no children.

Ecological Environment: Perceptions of the ecological environment (e.g., air quality, water pollution, climate change) may shape families' fertility choices. Concerns about poor environmental conditions may reduce willingness to have more children, while confidence in a healthy environment may encourage larger families.

Health: The health status of both spouses directly influences fertility capacity and intentions. Healthy couples may be more inclined to have additional children, whereas poor health may limit fertility intentions due to concerns over personal or child health.

Satisfaction with Medical Conditions: Satisfaction with healthcare affects families' expectations regarding health risks and medical expenses. Families satisfied with medical conditions may feel more confident about having more children, while dissatisfaction may discourage fertility.

Type of Health Insurance: Different health insurance schemes offer varying levels of coverage and economic support. Families with comprehensive insurance may hold a more positive attitude toward having additional children, while those with inadequate insurance may avoid further fertility due to concerns over medical expenses.

Controlling these variables minimizes external influences, enabling a more precise assessment of digital life's impact on fertility decisions.

4.Empirical Results Analysis

4.1Baseline Regression

Table 1 The Impact of Digital Life on Second-Child Fertility

	Second-Child Fertility
Digital Life	-0.1019***
	(-4.26)
Life Satisfaction	0.0278
	(0.56)
Household Income	-0.1851***

	(-3.12)
Household Social Status	0.1059*
	(1.84)
Evaluation of Local Government	-0.0031
	(-1.37)
Ecological Environment	-0.0104
	(-0.51)
Health	0.0414
	(0.88)
Satisfaction with Medical Conditions	0.0647
	(1.19)
Type of Health Insurance	-0.1130***
	(-3.40)
Hukou status	-0.3630***
	(-2.34)
_cons	-1.0897*
	(-1.73)
Wald chi2	78.67***
R^2	0.056
N	2682

*** p<0.01, ** p<0.05, * p<0.1，same applies hereafter.

Table 1 presents a random-effects logistic regression analysis of the impact of digital life on second-child fertility. The Wald chi-squared statistic for the model is 78.67 (p<0.01), indicating strong overall explanatory power for the model. Digital life has a significantly negative impact on the decision to have a second child, with a coefficient of -0.1019 (p<0.01). This result suggests that greater internet use in work, learning, entertainment, and consumption significantly reduces the likelihood of having a second child. This may reflect that high-intensity digital life consumes family members' time and energy, increases parenting costs, or reshapes fertility perceptions, reducing the willingness to invest in child-rearing. Control variables such as income, health insurance type, and hukou status also significantly influence fertility decisions.

4.2 Discussion on Endogeneity

Digital life and other explanatory variables might correlate with unobserved factors, such as family cultural background or policy impacts, potentially causing endogeneity issues. Endogeneity may arise when key factors influencing both the dependent and explanatory variables are excluded from the model. For example, a family’s decision to have a second child might result in reduced internet usage for entertainment and consumption, thereby altering their digital life. Additionally, inaccuracies in measuring the explanatory variables may also contribute to endogeneity. To address potential endogeneity, this study employs the instrumental variable (IV) approach, with the family's perception of digital life selected as the instrumental variable. This perception significantly affects

how often and intensively the internet is used for work, learning, entertainment, and consumption. It determines the family's level of engagement with digital life, including decisions to purchase and use digital devices or frequently access the internet. Moreover, as a cognitive and attitudinal factor, the family's perception of digital life does not play a direct role in their decision to have a second child. While such perceptions may shape behavioral patterns, they do not directly impact fertility decisions, which are influenced by complex economic, social, and cultural factors. Instead, digital life perception reflects acceptance of modern lifestyles, rather than fertility choices. To handle endogeneity, this study applies a two-stage logistic regression model. The instrumental variable analysis results for family perceptions of digital life are presented in the following table 2.

Table 2 Instrumental Variable

Instrumental Variable	Description
Perception of Digital Life	Importance of the internet for work, leisure and entertainment, staying connected with family and friends, learning, daily activities, and as an information source.

Two-Stage Logit Regression: First Stage, Instrumental Variable Regression:

$$X_i = \pi_0 + \pi_1 * Z_i + \pi_2 * W_{\{i1\}} + \ ... \ + \pi_k * W_{\{ik\}} + u_i \qquad (4-1)$$

X_i is the endogenous explanatory variable, Z_i is the instrumental variable, $W_{\{i1\}}$, $W_{\{i2\}}$,..., $W_{\{ik\}}$ are the control variables, u_i is the error term, and π_0, π_1..., π_k are the regression coefficients.

The second stage, Logit model, can be expressed as follows:

$$logit\left(P\left(y_{\{it\}}=1\right)\right) = \frac{1}{\left[1+\exp\left(-\left(\beta_0+\beta_1*X_i+\gamma*residual_X+\beta_2*W_{\{i1\}}+\cdots+\beta_k*W_{\{ik\}}\right)\right)\right]} (4-2)$$

$logit\left(P\left(y_{\{it\}}=1\right)\right)$ represents the log-odds of having a second child, X_i is the endogenous explanatory variable, $residual_X$ is the residual from the first-stage regression used to control for endogeneity, $W_{\{i1\}}$, $W_{\{i2\}}$, …, $W_{\{ik\}}$ are the control variables, and $\beta 1, \beta 2, \ldots \beta k$ are the regression coefficients for the second stage.

Table 3 Instrumental Variable Regression on the Impact of Digital Life on Second-Child Fertility

	（1）	（2）
Perception of Digital Life	0.2051***	
	(26.72)	
Digital Life		-0.1855***
		(-3.54)
$residual_X$		0.1052*
		(1.83)
Control	YES	YES
_cons	0.7284 *	-0.8781
	(1.53)	(-1.36)
F-measure	118.36	

R^2	0.36	0.058
N	2682	2682

The results from the instrumental variable regression analysis are shown in Table 3.In the first-stage regression, family digital life perceptions are used as an instrumental variable to predict the endogenous explanatory variable—digital life. The results show a significant positive relationship between family digital life perceptions and digital life, with a coefficient of 0.2051 ($p < 0.01$). This confirms the relevance of the instrumental variable, indicating that family attitudes toward digital life significantly influence actual behaviors. In the second-stage random-effects Logit regression, the residuals from the first stage (residual_X) are included as an additional explanatory variable to address endogeneity. The results reveal that digital life has a significant negative effect on the decision to have a second child, with a coefficient of -0.1855 ($p < 0.01$). This supports the theoretical expectation that high-intensity digital life may reduce family resources and time for childbearing or alter fertility preferences, lowering the likelihood of having a second child. The first-stage residual (residual_X) is nearly significant in the second-stage regression, with a coefficient of 0.1052 and a p-value of 0.067. This suggests the presence of endogeneity in the model. By applying a manual two-stage regression, the model partially corrects for this bias.

4.3 Robustness Checks

Robustness checks, detailed in Table 4, confirm the consistency of our findings. Robustness checks are essential for validating model reliability. This study conducted tests by adding control variables, applying family-clustered robust standard errors, and using a Probit model. Additional controls included whether the child attends tutoring classes and whether grandparents or elders provide childcare. These variables capture differences in family resources, such as time, financial support, and caregiving, which are key factors in fertility decisions. To address potential within-family correlations, family-clustered robust standard errors were used. The model was also re-estimated with a Probit specification to ensure the findings are not model-dependent. The results, shown in the table below, confirm the findings' consistency and robustness, supporting the conclusion that digital life significantly impacts fertility decisions.

Table 4 Robustness Checks

	（1）	（2）	(3)
Digital Life	-0.1867***	-0.1854 ***	-0.0552***
	（-3.59）	(-3.44)	(-4.20)
Control	YES	YES	YES
_cons	-0.7828	-0.8781	-0.6564*
	(-1.22)	(-1.40)	(-1.81)
N	2682	2682	2682

In Model (1), additional control variables were introduced. Model (2) applied family-clustered robust standard errors for re-estimation. Model (3) replaced the original model with a Probit specification. These robustness tests—addressing additional influencing factors, adopting robust standard errors, and exploring alternative model specifications—consistently show that digital life exerts a significant negative effect on second-child fertility decisions. The findings are both stable and consistent across different approaches.

4.4 Mechanism Analysis

Based on the theoretical analysis, this paper examines the mechanisms through which digital life affects second-child fertility from three dimensions: time displacement, parenting pressure, and parenting attitudes. For the time displacement mechanism, the household's average weekly working hours are used as the key variable. For the parenting pressure mechanism, variables are derived from survey questions related to parenting burden, including the following five items: "Parents should economize to pay for education," "Parents are responsible for their child's academic performance," "Parents are responsible for their child's financial independence," "Parents are responsible for their child's family harmony," "Parents are responsible for their child's emotional well-being," and "Parents are responsible if their child has an accident."

Parenting attitudes are measured using questions about the purpose of having children. These attitudes are divided into two categories: traditional and modern. "Traditional parenting attitudes" include reasons such as "to have support in old age," "to continue the family line," "to receive financial help from children," and "to strengthen kinship ties," which emphasize the instrumental and functional value of children. In contrast, "modern parenting attitudes" include reasons such as "to enjoy watching the child grow up," "to experience the joy of having children nearby," "to feel the happiness of parenthood," "to make the family more important," and "to make the family more complete," which focus more on the emotional satisfaction and sense of family integrity that children bring. Each item is rated on a five-point scale, with higher scores indicating stronger agreement. This paper calculates the average score for each category and uses them as key variables to identify the mechanisms through which digital life affects second-child fertility. The results are presented in the following table 5.

Table 5 Mechanism Analysis

	Weekly Working Hours	Parenting Pressure	Traditional Parenting Attitudes	Modern Parenting Attitudes
Digital Life	1.5942**	0.4121***	-0.0928***	0.0234***
	(1.99)	(3.81)	（-4.66）	（2.98）
Control	YES	YES	YES	YES
_cons	1.0155	0.9817	1.8514	0.4213
	(1.02)	(1.27)	（0.898）	（1.56）
N	2682	2682	2682	2682

The mechanism analysis provides evidence on how digital life affects second-child fertility through time displacement, parenting pressure, and parenting attitudes. The results show that digital life is significantly and positively associated with the average weekly working hours of household members. Specifically, a one-unit increase in digital life intensity raises average weekly working hours by approximately 1.5942 hours. This finding is consistent with the theoretical framework, as the growing prevalence of remote work and online learning may extend parents' working time. Longer working hours reduce the time available for childcare, increase the opportunity cost of parenting, and ultimately suppress second-child fertility. These results highlight the role of time displacement as an important mechanism through which digital life indirectly influences fertility behavior.

In addition, digital life significantly increases parenting pressure. The regression results indicate that each one-unit increase in digital life is associated with a 0.4121 rise in perceived parenting pressure. In a digital environment, parents are exposed to excessive information, face higher expectations regarding parenting quality, and frequently compare themselves with others through social media. These factors amplify the perceived burden of parenting, leading families to be more cautious and hesitant about having a second child. Therefore, parenting pressure functions as a second key channel linking digital life to lower fertility.

Moreover, digital life reshapes parenting attitudes, which further affects actual fertility behavior. The results show that digital life significantly weakens traditional parenting attitudes (coefficient = –0.0928, significant at the 1% level). Traditional attitudes, which emphasize the instrumental value of children—such as old-age support, family lineage continuation, and economic contribution—are challenged in a digital context. As families increasingly adopt modern lifestyles and values, they reassess the costs and benefits of having more children, making them less likely to have a second child.

By contrast, digital life slightly strengthens modern parenting attitudes (coefficient = 0.0234, significant at the 1% level). Modern attitudes emphasize emotional satisfaction and family completeness, which may encourage some families to consider second-child fertility. However, the magnitude of this positive effect is far smaller than the negative effect associated with the weakening of traditional attitudes.

Taken together, these findings indicate that digital life suppresses second-child fertility mainly by increasing time constraints, heightening parenting pressure, and weakening traditional parenting attitudes. Although its positive influence through modern parenting attitudes exists, it is insufficient to offset these dominant negative mechanisms. These results confirm that digital life shapes not only fertility intentions but also actual fertility behavior through multiple interacting pathways.

5. Further Research

5.1 Moderation Effects

In the previous mechanism analysis, this paper found that digital life significantly alters family parenting attitudes: it weakens traditional parenting attitudes, such as "raising children for old-age support," while at the same time modestly strengthening modern parenting attitudes that focus on emotional satisfaction. However, these mechanism results only confirm that digital life reshapes the structure of parenting attitudes. They do not answer a key question: to what extent do traditional or modern parenting attitudes modify the effect of digital life on second-child fertility behavior?

To address this question, this paper introduces a moderating effect analysis, using traditional and modern parenting attitudes as moderating variables. This approach examines whether these attitudes change the relationship between digital life and second-child fertility behavior. If traditional parenting attitudes have a "buffering effect," the negative impact of digital life may be mitigated in families with stronger traditional attitudes. Conversely, if modern parenting attitudes exert an "amplifying effect," the negative impact of digital life could be further reinforced in families with stronger modern attitudes. By conducting this extended analysis, we can more clearly reveal the interaction between digital life, parenting attitudes, and second-child fertility behavior, thereby providing more targeted empirical evidence for fertility-support policies.

In addition, this paper also considers three other moderating factors: healthcare accessibility, parenting support, and education. Specifically, we use the quality of local healthcare services,

whether grandparents help with childcare, and whether the child attends tutoring classes as additional moderating variables. The results of the moderating effect analysis are presented in Table 6.

Table 6 Moderation Effects

	（1）	（2）	（3）	（4）	(5)
Digital Life	-0.0145*	-0.0655***	-0.0202	-0.1123***	-0.0838***
	（-1.64）	（-3.64）	(-0.43)	(-4.11)	(-3.44)
Digital Life * Traditional Parenting Attitudes	-0.0277***				
	(-3.24)				
Digital Life * Modern Parenting Attitudes		0.0543***			
		（4.922）			
Digital Life * Medical Conditions			-0.3988**		
			(-2.82)		
Digital Life * Childcare				0.0398	
				(-1.27)	
Digital Life * Tutoring Classes					-0.0014**
					(-2.31)
Control	YES	YES	YES	YES	YES
_cons	0.8911	0.1699	-1.3339**	-0.9803	-1.2438*
	（0.933）	（0.103）	(-2.09)	(-1.54)	(-1.97)
N	2682	2682	2682	2682	2682

First, the interaction term between digital life and traditional parenting attitudes is -0.0277 and significant at the 1% level. This result indicates that in families with stronger traditional parenting attitudes, the negative effect of digital life on second-child fertility is even more pronounced. At first glance, this appears to contradict the fertility-promoting role of traditional attitudes. However, from the perspective of real-world constraints, the accumulation of time displacement and parenting pressure in a digital environment may exacerbate the conflict faced by families with strong traditional attitudes. As a result, these families are more likely to abandon the decision to have a second child. In other words, there is a "conflict effect" between traditional parenting attitudes and digital life, which ultimately strengthens the suppressive impact of digital life.

Second, the interaction term between digital life and modern parenting attitudes is 0.0543 and significant at the 1% level, suggesting that modern parenting attitudes have a significant buffering effect on the negative impact of digital life. Modern parenting attitudes emphasize emotional satisfaction and family completeness, which align more closely with the information-driven

parenting methods and flexible resource utilization enabled by digital life. Families with stronger modern parenting attitudes are more likely to leverage digital tools to improve childcare efficiency, thereby partially offsetting the negative effect of digital life on second-child fertility.

Third, the moderating effect of healthcare accessibility also deserves attention. The interaction term between digital life and healthcare accessibility is -0.3988 and significant at the 5% level, indicating that in families with better medical coverage, the negative effect of digital life is amplified. This finding is consistent with the "crowding-out effect" of social security: when healthcare coverage effectively mitigates health risks, the instrumental value of having children as a form of old-age support diminishes. Combined with the high opportunity cost introduced by digital life, families become less likely to have a second child.

Furthermore, grandparental childcare support significantly alleviates the negative effect of digital life, as indicated by the positive interaction term of 0.0398 ($p<0.05$). Grandparents can share a substantial portion of the time and effort required for childcare, reducing the competition between digital life and parenting, and thereby partially releasing the family's fertility potential.

Finally, the interaction term between digital life and tutoring is -0.0014 and significant at the 5% level, indicating that educational pressure intensifies the suppressive effect of digital life on second-child fertility. Tutoring not only increases household education expenses but also adds to the time burden of parenting, further reinforcing the negative impact of digital life.

In summary, the moderating effect analysis shows that the influence of digital life on second-child fertility is neither linear nor uniform but is significantly shaped by parenting attitudes, childcare support, and educational burden. Specifically, traditional parenting attitudes and educational pressure strengthen the negative effect of digital life, while modern parenting attitudes and grandparental childcare support partially mitigate this adverse impact. These findings deepen our understanding of the mechanisms linking digital life and fertility behavior and provide empirical evidence for designing more targeted fertility-support policies.

5.2 Heterogeneity of Digital Life

This study divides digital life into three categories—work and study, entertainment, and consumption—to examine their distinct impacts on second-child fertility decisions. The results are summarized in the Table 7.

Table 7 Heterogeneity of Digital Life

	（1）	（2）	(3)
Work and Study Digital Life	-0.0846***		
	（-3.86）		
Entertainment Digital Life		-0.0806***	
		（-3.41）	
Consumption Digital Life			-0.0220
			(-1.04)
Control	YES	YES	YES
_cons	-1.333**	-0.8489	-1.353**
	(-2.09)	(-1.31)	(-2.13)

N		2682	2682	2682

Digital life related to work and study significantly reduces the likelihood of having a second child, with each unit increase leading to a 0.0846 decline. This reflects how the digitalization of work and education demands substantial time and energy, leaving parents with limited capacity for additional children. Similarly, entertainment-related digital life has a notable negative effect, with each unit increase reducing the likelihood of a second child by 0.0806. Activities such as social media, video games, and streaming services occupy leisure time and alter family lifestyles, reducing interaction and parent-child bonding, which weakens the motivation for more children. In contrast, consumption-related digital life shows no significant impact on second-child fertility decisions. Although the effect is negative, it does not reach statistical significance. This may be because consumption activities, such as financial management and transactions, require less time and energy and are more flexible, causing minimal disruption to fertility plans. These findings reveal how different aspects of digital life influence fertility decisions, with time and energy constraints playing a key role.

5.3 Other Heterogeneity

This study examines the heterogeneity of digital life's impact on second-child fertility across policy environments, urban-rural differences, economic conditions, and the gender of the first child. Specifically, policy heterogeneity is analyzed by comparing the periods before (2014–2016) and after (2018–2020) the implementation of the "Universal Two-Child Policy." The key results are presented in the Table 8.

Table 8 Other Heterogeneity

Policy Heterogeneity	Pre-Universal Two-Child Policy	-0.0890**
		(-2.19)
		1360
	Post-Universal Two-Child Policy	-0.2719***
		(-4.50)
		1322
Urban-Rural Heterogeneity	Urban Areas	-0.1333***
		(-4.40)
		1588
	Rural Areas	-0.0432
		(-0.97)
		1094
Economic Conditions Heterogeneity	Better Economic Conditions	-0.1633***
		(-4.38)
		1366
	Poorer Economic Conditions	-.0386
		(-1.09)

	N	1366
First-Child Gender Heterogeneity	First Child is a Boy	-0.1511***
		(-3.99)
	N	982
	First Child is a Girl	-0.0276
		(1.17)
	N	791

First, the impact of digital life on second-child fertility varies before and after the implementation of the "Universal Two-Child Policy." Before the policy, the negative effect of digital life was relatively weak, with a coefficient of -0.0890, indicating only a mild suppressive effect. After the policy, the effect became significantly stronger, with a coefficient of -0.2719. This suggests that, although the policy increased the legitimacy and acceptance of having a second child, it failed to alleviate family pressures or time constraints. In an increasingly competitive environment, families may rely more on digital platforms for maintaining their lifestyle or managing stress, further discouraging them from having a second child.

Second, in the urban-rural analysis, digital life has a significant negative effect on second-child fertility in urban areas, with a coefficient of -0.1333. Urban families, facing higher work demands and a faster pace of life, are more likely to reduce family size. In contrast, the impact in rural areas is not significant, likely due to lower digital adoption or the persistence of traditional fertility norms.

Third, under different economic conditions, digital life significantly reduces second-child fertility in families with better economic conditions, with a coefficient of -0.1633. Even with favorable economic circumstances, these families may still limit childbearing due to the time and resource demands associated with digital life. In poorer families, the effect of digital life is not significant, as immediate financial pressures dominate their fertility decisions.

Finally, regarding the gender of the first child, digital life significantly lowers the likelihood of a second child in families with a first-born boy, with a coefficient of -0.1511. These families may already prefer fewer children and find their inclination reinforced by the demands of digital life. For families with a first-born girl, the effect is not significant, possibly because these families are still motivated to have a second child to pursue a son, making digital life's influence weaker.

6.Discussion

The results of this study underscore the complex relationship between digital life and second-child fertility decisions in Chinese households, offering insights that both align with and expand upon existing literature. First, the finding that digital life negatively impacts second-child fertility is consistent with previous studies that attribute such effects to time displacement and increased parenting pressures (Nie et al., 2023; Du & Mao, 2023)[24][20]. Specifically, the significant influence of work and study-related digital activities highlights how technological integration in professional and educational domains consumes family resources and diminishes their capacity for childbearing. This supports Becker's family production model, which emphasizes resource reallocation as a key determinant of fertility decisions.

The heterogeneity analysis further illuminates the nuanced effects of digital life across different contexts. For instance, the stronger negative impact of digital life in urban areas compared to rural areas underscores the role of lifestyle and cultural differences in shaping fertility decisions. Urban

households, characterized by greater digital engagement and higher opportunity costs, face more pronounced constraints. Conversely, the relatively weaker effects in rural areas may reflect limited digital penetration and the persistence of traditional fertility norms, as suggested by Ni and Cai (2015)[7].

Economic status and the gender of the first child also emerge as significant moderating factors. The amplified negative effects in economically advantaged households align with findings that higher resource availability often correlates with increased opportunity costs of childbearing (Feng et al., 2020)[14]. Similarly, the pronounced impact of digital life in families with a first-born boy may reflect shifting cultural expectations, where traditional gender norms are disrupted by digital engagement. These results extend the work of Liu et al. (2021) by demonstrating how digital life reshapes intergenerational dynamics and fertility preferences[26].

The policy heterogeneity analysis offers critical insights into the unintended consequences of the "Universal Two-Child Policy." While the policy intended to alleviate fertility constraints, its implementation coincided with a growing digital landscape that amplified time and parenting pressures. This suggests that policy efforts to encourage fertility must account for broader sociotechnical dynamics, including digitalization and its impacts on family life.

These findings have significant implications for policymaking. Efforts to address declining fertility rates must go beyond traditional economic incentives and consider interventions that balance digital engagement with family well-being. Policies promoting flexible work arrangements, improved childcare support, and digital literacy programs could help mitigate the negative effects of digital life on fertility. Moreover, targeted strategies for urban and rural households, as well as for families with varying economic conditions and cultural expectations, are essential to create a more fertility-friendly environment.

Overall, this study contributes to the literature by integrating digital life into the analysis of fertility decisions and highlighting its multifaceted impacts. Future research could explore longitudinal effects of digital life on family dynamics and fertility, as well as cross-cultural comparisons to understand how digitalization interacts with diverse social and policy contexts.

7. Conclusion and Recommendations

Based on Becker's household production theory, this paper systematically examines how digital life influences second-child fertility through the channels of time displacement, parenting pressure, and changes in parenting attitudes. Using panel data from the CFPS for 2014, 2016, 2018, and 2020, the empirical results demonstrate that digital life exerts a significant negative effect on second-child fertility. This effect operates primarily through the occupation of parents' time and energy, the intensification of parenting pressure, and the transformation of parenting attitudes within the digital environment.

Further analysis reveals that local healthcare accessibility and children's educational burden amplify this negative effect, whereas modern parenting attitudes and grandparental childcare support serve as important mitigating factors. These findings highlight the conditional nature of digital life's impact on fertility behavior, suggesting that its influence is shaped by both family-level resources and external support systems.

The heterogeneity analysis provides additional insights. The negative effect of digital life on second-child fertility is primarily driven by digital activities related to work, study, and entertainment, and this pattern has not been alleviated by the implementation of the "universal two-

child" policy. Moreover, the effect varies significantly across income groups: it is more pronounced in higher-income families, while weaker among lower-income households. The analysis also reveals gender-based differences: for families whose first child is a boy, digital life significantly reduces the probability of having a second child, whereas for families whose first child is a girl, the effect is not statistically significant.

Taken together, these findings provide robust evidence that digital life has reshaped the determinants of fertility behavior in China. They underscore the need for targeted policy interventions that not only address the economic and temporal constraints imposed by digital life but also leverage moderating factors—such as childcare support and the promotion of modern parenting values—to mitigate its adverse effects and create a more supportive environment for second-child fertility.

To address these challenges, the government should prioritize balancing digital and family life. Public campaigns can encourage families to manage their time effectively, reducing over-reliance on digital platforms and minimizing their impact on family dynamics and parenting quality. Employers should be incentivized to adopt flexible work policies, such as remote work arrangements that integrate with family life, to ease time constraints. Parenting support policies should focus on expanding public childcare services to reduce parenting burdens and enhance fertility intentions. Psychological support programs can help parents cope with stress caused by information overload and high expectations, fostering greater confidence in parenting. Finally, policies should target families at different economic levels. Economically disadvantaged families should receive greater financial support, including childcare subsidies and educational assistance, to alleviate economic pressures. Differentiated strategies should also be developed for urban and rural areas to address the distinct effects of digital life on fertility decisions. By implementing these measures, the government can build a fertility-friendly society, addressing the challenges of low fertility in the digital age while promoting sustainable population and economic growth.

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Data Availability
The data used in this study are obtained from the China Family Panel Studies (CFPS), which are publicly available at https://cfpsdata.pku.edu.cn/#/home. Access to the data requires user registration and compliance with the data usage policies of Peking University's Institute of Social Science Survey.

Author Contributions
Liao was the primary author of the manuscript and was responsible for the conceptualization, theoretical framework, and empirical analysis. Luo, as the academic advisor, provided guidance on the research design, theoretical refinement, and overall manuscript revision. Yan was mainly responsible for data collection, data processing, and the measurement of key variables. All authors reviewed and approved the final version of the manuscript.

Conflict of Interest
The authors declare no conflict of interest.