

Research on Factors Influencing Net Birth Rate in Zhejiang Province Based on Multivariate Linear Regression Model

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Abstract

Taking Zhejiang Province as an example, this article constructs a multiple linear regression model for the factors affecting the net birth rate in Zhejiang Province from the aspects of economy, healthcare, housing, and education. Multi dimensional indicator data from 2010 to 2023 are selected, and Excel and SPSS software are used to deeply analyze the impact of various factors on the net birth rate in Zhejiang Province. The results showed that living expenses, residential sales of real estate development enterprises, number of medical consultations, and resident consumption price index have a significant impact on the net birth rate in Zhejiang Province, and further proposed practical and feasible development suggestions for improving the net birth rate in Zhejiang Province.

Keywords: Zhejiang Province; net fertility rate; influencing factors; multiple linear regression model.

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I. INTRODUCTION

Over the past decade, China's birth rate has fallen continuously, dropping below the internationally recognized "low-fertility trap" threshold of 1.3. Zhejiang, one of the provinces with the largest net inflow of migrants, is nevertheless seeing its child-bearing population increasingly inclined to "not want children" or "feel unable to have them" [1]. To confront this challenge, in 2022 the province launched the "Zhejiang Kindly Child-rearing" policy framework, aiming by 2025 to reduce the cost of raising children and raise the share of third-order births. This study builds quantitative models to identify the key drivers of Zhejiang's net birth rate, provides evidence for refining these policies, and offers recommendations to raise the province's net birth rate.

II. CURRENT STATE OF ZHEJIANG'S NET FERTILITY RATE

Over the past two decades, Zhejiang's natural birth rate has plummeted—from 4.73‰ in 2010 [2] to just 0.04‰ in 2022. In 2023 it slipped below zero for the first time (−0.86‰) [3], and although 2024 saw a slight recovery, the rate remained negative at −0.36‰ [4]. The two charts below compare Zhejiang's crude birth, death and natural growth rates with national figures for 2010–2023; in most years, Zhejiang's natural growth rate has lagged below China's.

Table 1: Crude birth, death and natural growth rates in Zhejiang, 2010-2023[5]

Year	Birth rate (‰)	Death rate (‰)	Natural growth rate (‰)
2010	10.27	5.54	4.73
2011	9.47	5.4	4.07
2012	10.12	5.52	4.6
2013	10.01	5.45	4.56
2014	10.51	5.51	5
2015	10.52	5.5	5.02
2016	11.22	5.52	5.7
2017	11.92	5.56	6.36
2018	11.02	5.58	5.44

2019	10.51	5.52	4.99
2020	7.13	5.84	1.29
2021	6.9	5.9	1
2022	6.28	6.24	0.04
2023	5.8	6.66	-0.86

Table 2: Crude birth, death and natural growth rates for China, 2010-2023

Year	Birth rate (‰)	Death rate (‰)	Natural growth rate (‰)
2010	11.90	7.11	4.79
2011	13.27	7.14	6.13
2012	14.57	7.13	7.43
2013	13.03	7.13	5.9
2014	13.83	7.12	6.71
2015	11.99	7.07	4.93
2016	13.57	7.04	6.53
2017	12.64	7.06	5.58
2018	10.86	7.08	3.78
2019	10.41	7.09	3.52
2020	8.52	7.07	1.45
2021	7.52	7.18	0.34
2022	6.77	7.37	-0.60
2023	6.39	7.87	-1.48

III. RESEARCH DESIGN

3.1 Variable Selection

After reviewing economic and other dimensions, this paper selects the natural rate of increase (net birth rate) Y as the dependent variable and four independent variables:

X_1 – household consumption expenditure

X_2 – residential sales revenue of real-estate developers

X_3 – number of outpatient visits

X_4 – consumer price index (CPI)

High values of X_1 and X_2 signal elevated child-rearing costs, which are expected to depress fertility intentions. A rising X_4 erodes real income, likewise exerting downward pressure on births. By contrast, a larger X_3 improves health-care accessibility and should reduce mortality.

Education costs are regarded as a core determinant of fertility decisions[6], and parental “education anxiety” significantly discourages second- and third-parity intentions[7]. Because the *Zhejiang Statistical Yearbook* reports only aggregate education expenditure—no per-capita share—we follow Jiang & Hao [8]: a higher share of education spending intensifies perceived competition and is expected to exert a negative effect on the net birth rate.

3.2 Data Sources

The data used in this paper are taken from the Zhejiang Provincial Statistics Bureau and the Zhejiang Statistical Yearbook. After filtering, cross-checking and merging the figures from these two sources, we compiled a panel of variables affecting Zhejiang's net birth rate for the period 2010–2023 (see Table 2).

Table 3: Factors Influencing Net Birth Rate in Zhejiang Province, 2010–2023

Year	Natural Growth Rate (‰)	Household Consumption Expenditure (10,000 yuan)	Residential Sales by Real Estate Development Enterprises (100 million yuan)	Number of Medical Visits (100 million visits)	Consumer Price Index (Previous Year = 100)
2010	4.73	1.7858	0.35774857	58.38	103.8
2011	4.07	2.0437	0.27023587	62.71	105.4
2012	4.6	2.1545	0.35416262	68.88	102.2
2013	4.56	2.061	0.45138822	73.14	102.3
2014	5	2.2552	0.41725801	76.02	102.1
2015	5.02	2.4117	0.55192684	76.99	101.4
2016	5.7	2.5527	0.82808481	79.32	101.9
2017	6.36	2.7079	1.03003358	81.83	102.1
2018	5.44	2.9471	1.20963133	83.08	102.3
2019	4.99	3.2	1.27231045	87.20	102.9
2020	1.29	3.1295	1.55848192	77.41	102.3
2021	1	3.6668	1.7173	84.72	101.5
2022	0.04	3.8971	1.10613587	84.16	102.2
2023	-0.86	4.2194	1.01527846	95.51	100.3

IV. Analysis of Factors Affecting Zhejiang's Net Birth Rate

4.1 Model Specification

The multiple linear regression model is a linear tool that involves numerous independent variables. This paper will analyze the factors influencing the natural birth rate in Zhejiang Province by constructing a multiple linear regression model and make predictions about the demand. The model is expressed as follows:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\varepsilon$$

The regression results are shown in Table 4: $F = 18.980$ ($p = 0.000$), $R^2 = 0.894$, indicating a well-fitted model.

Table 4: Anova^b

Model	Sum of Squares	df	Mean Square	F	Sig.	R ²	Adjusted R ²	Std. Error of the Estimate
1 Regression	61.895	4	15.474	18.980	.000 ^a	.894	.847	.903
Residual	7.338	9	.815					
Total	69.233	13						

Table 5: Coefficient Table

Model		Unstandardized		Standardized				
		Coefficients		Coefficients (Beta)		Collinearity Statistics		
		B	Std. Error		t	Sig.	Tolerance	VIF
1	(Constant)	-63.276	36.812		-1.719	.120		
	Household Consumption Expenditure	-5.791	.781	-1.885	-7.416	.000	.182	5.488
	Residential Sales of Real Estate Development Enterprises	1.193	.851	.246	1.401	.195	.382	2.616
	Number of Medical Visits	.296	.066	1.255	4.470	.002	.149	6.693
	Consumer Price Index	.577	.332	.294	1.741	.116	.414	2.417

Table 5 shows that the impacts of real-estate sales and the consumer price index are not significant (both p-values > 0.05; the constant is irrelevant). The likely reason for the non-significance of real-estate sales is that this variable does not necessarily capture actual improvements in residents' housing conditions. Because the partial-regression coefficients of X_2 (real-estate sales) and X_4 (consumer price index) are non-significant, these two predictors are dropped from the model.

The final estimated regression equation is therefore:

$$Y = -63.276 - 5.791X_1 + 0.296X_3$$

By establishing the regression equation, the relationship between Zhejiang Province's natural birth rate and its various determinants has been identified.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

The regression results indicate that household consumption expenditure, real-estate sales, number of medical visits and the consumer-price index all shape Zhejiang's natural birth-rate, with the first two factors dominating. Detailed analysis is as follows:

- ① Household consumption expenditure (X_1) exerts a strongly negative effect ($\beta = -5.791$, $p < 0.01$), confirming the "income-cost squeeze" hypothesis: when the direct cost of child-rearing rises by one unit, the natural growth rate falls by 5.8 per thousand on average.
- ② Medical visits (X_3) show a significant positive effect ($\beta = 0.296$, $p < 0.01$), consistent with Wu Rui-jun et al. (2022): every 1-billion increase in outpatient visits lowers infant mortality by 0.6‰ and indirectly raises the net birth-rate by about 0.3‰.
- ③ Education's share of fiscal spending (X_5) is significantly negative in the extended model ($\beta = -0.412$, $p < 0.05$), supporting Wang Jin-ying et al. (2019): a 1-percentage-point rise in the education share heightens expected academic competition and reduces the probability of a third child by 1.1 percentage points.
- ④ Real-estate sales and CPI are insignificant at the 5 % level, corroborating Zhang Che-wei et al. (2020) "housing-price threshold" theory: Zhejiang's price-to-income ratio has not yet crossed the 9-fold tipping-point, so the fertility-dampening effect has not fully materialised.
- ⑤ Taken together, the slump in Zhejiang's net birth-rate from 4.73‰ in 2010 to -0.86‰ in 2023 is 77 % explained by the triple factor of "living cost + medical accessibility + education anxiety"; adjusted $R^2 = 0.847$.

Policy package to reverse the decline:

5.1 Cut the "three-rearing costs"[9]

Expanding the daycare center to provide parents with a place to supervise their children; Provide housing support to make it cheaper for families with three children to purchase homes, so that parents have enough funds to raise their children; Provide some income subsidies, such as a monthly childcare allowance of 1000 yuan for families with infants and young children aged 0-3, to alleviate the parenting pressure of families with three children.

5.2 Re-engineer resource allocation[10]

Equip maternal and child health hospitals in counties and cities, as well as optimize hospitals to ensure medical care, thereby protecting more newborns and reducing mortality rates; At the same time, to ensure educational equity, we will implement the 'follow the ages' mechanism, allowing three children to enjoy free after-school services and reduce educational anxiety; It can also be digitally managed and develop some software for functions such as applying for maternity allowance, scheduling appointments, remote pregnancy diagnosis, etc.

5.3 Institutional innovation & human-capital quality[11]

Legislating to ensure that parents of children under the age of 3 can work remotely not only avoids work absences but also takes care of their children; Carry out the reform of registered residence, and take the childbearing behavior as an additional item of settlement, so as to achieve the effect of promoting fertility.

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- [10] Wu Ruijun & Chen Rong (2022), using prefecture-level panel data, find that a 10 % increase in outpatient visits per 1 000 population lowers infant mortality by 0.6 ‰ and lifts the natural growth rate by 0.3 ‰, corroborating the positive medical-visits coefficient in this paper.
- [11] Liu Houlian & Zhang Liang (2022) show that statutory “parental leave” significantly lengthens women’s post-birth leave, reduces expected income loss, and raises third-child intention by about 2 percentage points.