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Where Did the Children go: The Configurational Effects of Changes in the Proportion of Urban Children in China

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Abstract

The gradual decline in the proportion of children represents an urgent scientific issue that demands effective solutions. Grounded in the "economy-population-environment" configurational framework, this study examines China's prefecture-level cities to investigate the drivers of this demographic shift. Employing a temporal multi-stage configurational approach at ten-year intervals, we analyze how economic, demographic, and environmental factors have influenced the child population share from 2000 to 2020. Using the child proportion as the outcome variable and selecting conditional variables across economic development, educational resources, infrastructure, fertility potential, social interaction, and air pollution, this research identifies six distinct configurational paths. The findings are threefold: First, in the economic dimension, persistently lagging economic development and a shortage of educational resources were consistently associated with a high proportion of children. Conversely, the role of infrastructure shifted from a deficiency to a key driving factor by 2020. Second, in the population dimension, social interaction consistently served as a promoting factor, while the influence of the proportion of women of childbearing age transitioned from low to high, indicating the gradual manifestation of fertility policies and enhanced social support. Third, in the environmental dimension, the impact of air pollution evolved from a marginal effect in the early stages to a significant inhibitory factor after 2010. This paper reveals the complex multi-factor interaction mechanisms and path-dependent characteristics underlying the proportion of children, thereby providing theoretical and empirical support for formulating differentiated and systematic population policies.

Keywords

Multi-factor; Children; Population Proportion; Interaction Effect; fsQCA.

1. Introduction

The declining proportion of children in the population is a long-term consequence of decreasing fertility rates (Sato, 2008). Globally, the share of the population aged 0-14 fell from 37% in 1960 to 25% in 2022, with over 35% of countries and regions reporting figures below 20%. This trend is particularly pronounced in East Asia. As the world's most populous country, China exemplifies this demographic shift. Its birth rate in 2023 was merely 6.39‰, with a natural population growth rate of -1.48‰. Individuals aged 0-14 now constitute only 17.95% of the total population, underscoring a pronounced trend of low fertility that has intensified since the turn of the 21st century (Gerland et al., 2014). Given China's substantial share of the global population and its status as a top-tier economy, the trajectory of its declining birth rate holds profound implications for global economic development, social stability, and international security. Consequently, investigating the factors influencing China's declining birth rate and their synergistic effects is of significant global importance.

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Previous research on population structure has predominantly concentrated on the proportion of the elderly (aged 60 and above). However, given the emerging trends of declining birth rates and a shrinking child population, a growing number of scholars are now directing their attention to the issue of low fertility. Existing literature on the causes of declining birth rates primarily explores the following dimensions: First, the influence of modernization. The advancement of modernization has fostered the proliferation of individualistic and consumerist values, enhanced women's independence and aspirations for personal life quality, and improved social security systems which mitigate eldercare risks. Collectively, these factors contribute to a reduction in fertility rates (Fauser et al., 2024; Cheng et al., 2022). Second, the enduring impact of population policies. China's family planning policy has significantly reshaped public childbearing intentions (Yang et al., 2024). Coupled with a lag in the transition of birth policies, this has resulted in a fertility rate that is difficult to reverse, exacerbated by an insufficient number of women of childbearing age and an imbalanced sex ratio (Wang et al., 2019). Third, increasing life pressures on the youth. The slowdown in economic growth, the bursting of the real estate bubble, the waning of the internet economy, rising unemployment, and escalating child-rearing costs (Adda, 2017) have exacerbated underlying social tensions. This has intensified social involution, increased life pressures on young people, and suppressed fertility desires (Bono et al., 2015). Fourth, incomplete fertility support policies. The delayed adjustment of fertility policies, combined with the path dependency of the long-standing family planning regime, has resulted in government support measures that are fragmented and severely inadequate, particularly concerning housing and education (Greulich, 2013; Yamada, 2020). Nonetheless, most existing studies focus on isolated dimensions or linear relationships, overlooking the interactive and combinatorial effects of economic, demographic, and environmental factors. In reality, different factors can act as prerequisites or substitutes for one another. For instance, high income may offset childcare costs, but it is often accompanied by increased female labor force participation; public childcare can supplement family care, but its effectiveness depends on employment stability and housing affordability. Identifying these complex configurational relationships is crucial for elucidating the multiple pathways that lead to low birth rates across different regional contexts.

Based on the configuration perspective, this study employs a methodological combination of fuzzy-set Qualitative Comparative Analysis (fsQCA) and Necessary Condition Analysis (NCA) to investigate the complex, interactive effects of economic, demographic, and environmental factors on changes in the proportion of children within a population. It seeks to address the following research questions: How do multidimensional elements couple to form specific population structures across different Chinese cities? What factors are necessary conditions for maintaining a high proportion of children? What alternative, equifinal pathways lead to a relatively balanced population structure? The potential contributions of this research are threefold. First, from a configurational viewpoint, it integrates a wider and more systematic set of influencing factors and identifies the various causal configurations that drive the trend of declining child population, thereby providing a conceptual framework for subsequent empirical research. Second, by combining fsQCA and NCA, it examines whether, and to what extent, specific economic, demographic, and social factors constitute necessary conditions for a higher child population proportion. Finally, the exploration of the complex impact of the "economy-demography-environment" configuration holds significant theoretical and practical importance for uncovering the causal pathways and mechanisms that lead to a higher proportion of children in the population.

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2. Theoretical Framework

2.1. The Impact of Economic, Demographic, and Environmental Factors on Low Fertility Trends

Changes in population structure result from multifaceted determinants. Drawing on existing literature, this study categorizes the influencing factors into three dimensions: economic, demographic, and environmental.

Economic factors constitute the fundamental conditions affecting the child population share. Regional economic development, educational resources, and infrastructure form the material basis for childbearing and parenting, thereby influencing fertility trends. First, the level of regional economic development is crucial. Higher economic development often correlates with increased urbanization, which elevates the cost of living and child-rearing expenses. Concurrently, improved public services may reduce reliance on children for old-age support, thereby diminishing fertility intentions and leading to a declining child population share (Xue, Zhen, & Wang, 2023). Second, educational resources play a significant role. Individuals with greater access to education typically possess more career opportunities and ambitions. To maintain a competitive edge in the labor market, they may postpone childbirth. Moreover, highly educated individuals often prioritize personal development and quality of life over traditional preferences for larger families, further reducing fertility rates (Yiannis, 2020). Third, infrastructure quality affects fertility decisions. High-quality infrastructure enhances family well-being by providing superior living and working conditions. For instance, the availability of sufficient and affordable housing is a critical factor in promoting fertility, as a safe and comfortable environment encourages childbearing. Conversely, crowded housing conditions or high costs may lead families to delay or reduce the number of children (Hathi, 2017).

Demographic and social structural factors influence low fertility trends through fertility potential, social interaction, and intergenerational support. Fertility potential, indicated by the size of the female population of reproductive age, constitutes a fundamental determinant of fertility rates and the child population share. A larger cohort of women of childbearing age provides a sufficient demographic base to support new births and natural population replacement, theoretically leading to a higher number of fertility events and consequently an increased child population share (Zhang et al., 2022). Social interaction, often reflected in population density and linked to urbanization, exerts a dual influence on fertility behavior. In areas with high urbanization rates and population density, frequent social interaction may suppress fertility intentions and reduce the child population share due to elevated living costs. Conversely, it may also foster pronatalist norms and increase the proportion of children (Chu et al., 2022). Intergenerational support, manifesting as grandparental childcare and multigenerational cohabitation, alleviates constraints on familial labor division. This form of social capital enhances the feasibility of childbearing for young families by providing alternative care when public childcare is insufficient (Yang et al., 2022). Furthermore, the intergenerational transmission of values within families perpetuates parental attitudes toward childbearing, including gender preferences and desired family size, across generations (Dong, 2024).

Public policies and the living environment form an external support system for childbearing and parenting, serving as an institutional foundation that shapes the child population share. Research indicates that robust social security systems, inclusive educational resources, and accessible childcare services can effectively alleviate parenting pressures (Fauser et al., 2024; Yamada, 2020). In contexts where public support is lacking, the heavy burden of privatized child-rearing becomes a key driver of persistently low fertility. Concurrently, housing affordability, neighborhood safety, and ecological quality directly shape families' subjective assessment of their parenting environment. Air pollution, urban congestion, and resource

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scarcity can heighten feelings of insecurity among young families, thereby suppressing their childbearing intentions (Adda, 2017). In cities with severe air pollution, high energy consumption and elevated particulate emissions may prompt families to postpone childbirth or relocate to areas with better environmental quality, even in the presence of favorable job opportunities, thus reducing the local child population share (Acheampong et al., 2022; Axinn, 2017). Conversely, regions characterized by higher quality of life and superior social welfare are more likely to sustain a higher child population share. Significant interregional disparities in public services, environmental quality, and social security systems across China result in markedly different levels of fertility feasibility among cities.

2.2. Research Framework

The configurational perspective, coupled with QCA methodology, is particularly suitable for analyzing the synergistic effects of economic, demographic, and environmental factors on low fertility trends, as it captures emergent "chemical-like" interactions among conditions. Grounded in this perspective, this study employs a multi-stage analytical approach integrating fsQCA and NCA to examine both necessary and sufficient causal relationships (Xue, Zhen, & Wang, 2023; Kountouris, 2020; Hathi et al., 2017). We construct an "economy-population-environment" tripartite framework to systematically interpret the complex mechanisms underlying declining fertility. Within this framework, economic factors form the foundational layer of family decision-making, directly determining practical capacities related to employment, income, and cost of living. The demographic dimension delineates the feasibility space for childbearing, encompassing institutional environments such as public services and social security that shape long-term childcare confidence. Environmental conditions, particularly air quality and ecological factors, increasingly influence residential and reproductive choices through their direct connection to health and safety. These three systems interact multiplicatively rather than operating in isolation or through simple addition—deficiencies in one domain can undermine the positive effects of others, potentially triggering cascading negative effects. For instance, abundant economic opportunities may fail to stimulate fertility in contexts of environmental degradation, while inequalities in public service provision can amplify economic constraints on childbearing. Such nonlinear interdependencies explain why isolated policy interventions often prove ineffective, necessitating configuration-based approaches to identify viable intervention pathways (as shown in Figure 1).

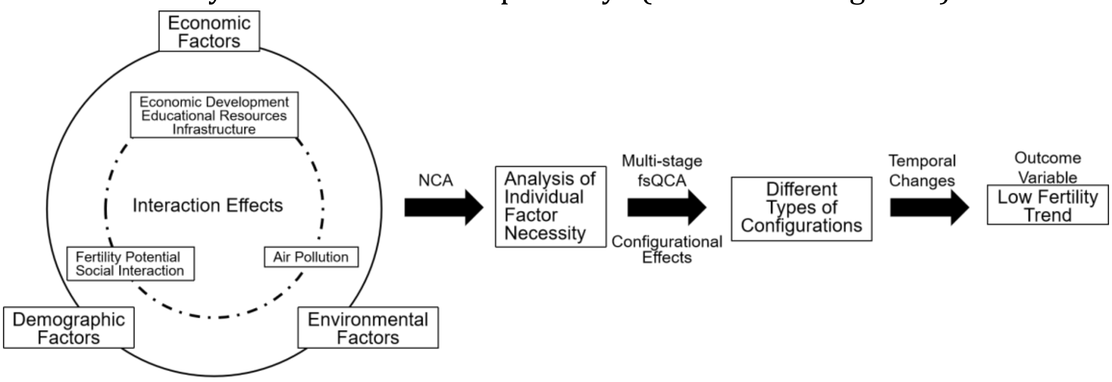

Figure 1. Research Framework on the Economy-Population-Environment System

3. Research Design

3.1. Research Methods

This study employs an integrated methodological approach combining Qualitative Comparative Analysis (QCA) and Necessary Condition Analysis (NCA) (Cooper & Glaesser, 2016). Both are established methodologies for analyzing causal complexity, with QCA focusing on sufficient conditions (causal configurations) and NCA on necessary conditions. Grounded in set theory

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and Boolean algebra, QCA identifies which combinations of antecedent conditions lead to the presence or absence of an outcome, moving beyond the "net effects" of traditional regression to examine multiple conjunctural causality (Brauner-Otto & Axinn, 2017). QCA encompasses both static methods—such as csQCA, mvQCA, and fsQCA—and dynamic approaches like multi-stage QCA, which address the "temporal blindness" of static analyzes (Kountouris, 2020). Given that the variables in this study are not purely binary and the declining birth rate trend exhibits distinct lifecycle patterns and temporal dynamics, multi-stage fsQCA is particularly appropriate. This method handles fuzzy-set membership scores between 0 and 1 and mitigates issues related to case period selection and non-robust configurations in longitudinal analysis.

The NCA method is specifically designed to identify necessary conditions for an outcome to occur. Typically, QCA involves two analytical stages: necessary condition analysis and sufficiency analysis. While necessary condition analysis identifies prerequisites for an outcome, sufficiency analysis reveals how different configurations of antecedent conditions are sufficient to produce it (Chu, Zhang & Wu, 2022; Alex et al., 2022; Brauner-Otto & Axinn, 2017). Compared to the necessity analysis within QCA, NCA offers distinct advantages: it not only determines whether a condition is necessary but also quantifies the degree of necessity through ceiling regression and ceiling envelope techniques. Furthermore, NCA's bottleneck analysis identifies specific levels of necessary conditions required to achieve different outcome levels. Leveraging the complementary strengths of both methods, this study first applies NCA to test necessary conditions for a high child population share, then employs fsQCA to analyze sufficient conditional configurations (Cooper & Glaesser, 2016; Du & Jia, 2017).

3.2. Case Selection and Variable Description

3.2.1. Case Selection and Data Sources

This study utilizes Chinese prefecture-level cities as its case base. Due to data availability constraints, a final sample of 270 cities was selected. The data are primarily drawn from China's Fifth (2000), Sixth (2010), and Seventh (2020) National Population Censuses, ensuring consistent decennial intervals for the explanatory variables.

3.2.2. Outcome Variable

While both the fertility rate and the child population share (the proportion of children aged 0-14 in the total population) are associated with low fertility trends, the latter provides a more stable and structurally informative metric. Fertility rates are susceptible to short-term fluctuations caused by economic shifts, policy changes, or social events, whereas the child population share offers a sustained perspective on a region's age structure, making it more suitable for evaluating the long-term effectiveness of population and socio-economic policies. Consequently, this study employs the proportion of children aged 0-14 as its outcome variable. A higher value indicates a less pronounced low fertility trend, and vice versa.

3.3. Conditional Variables and Their Measurement

3.3.1. Economic Development

Economic Development is proxied by the regional Gross Domestic Product (GDP) per capita. This indicator reflects the overall economic performance and average material well-being of a region, which directly shapes residents' quality of life, social welfare, and expectations of future economic security—key considerations in fertility decisions.

3.3.2. Educational Resources

Educational Resources are measured by the average years of schooling. This metric indicates both the availability of educational resources and the aggregate educational attainment of the population in a given area.

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3.3.3. Infrastructure

Infrastructure is assessed using the per capita housing floor area. As a critical component of household welfare, housing serves as the primary material foundation for childbearing and rearing in China. Moreover, it is deeply embedded in traditional Chinese norms surrounding marriage and fertility, making per capita housing area a significant factor influencing fertility behavior (Qu, Qin & Wang, 2023; Du, Liu & Cheng, 2020).

3.3.4. Fertility Potential

Fertility Potential is gauged by the proportion of women of reproductive age (15-49 years). This demographic segment defines the pool of potential births, and its size is a fundamental indicator of a society's inherent capacity for future population growth, allowing for a more accurate assessment of its impact on low fertility trends.

3.3.5. Social Interaction

Social Interaction is captured by population density. Denser populations facilitate more frequent daily interactions, which can strengthen social support networks and enhance communication between individuals. This environment is conducive to relationship formation and may increase the likelihood of childbearing (Du, Liu & Chen et al., 2022).

3.3.6. Air Pollution

Air Pollution is measured by the concentration of PM2.5—particulate matter with a diameter of 2.5 micrometers or less. Compared to other pollutants, PM2.5 has diverse sources, spreads widely, and poses significant health risks, establishing it as a primary metric for air quality and environmental health research. Chronic exposure to high PM2.5 levels can adversely affect reproductive health and may suppress childbearing intentions (Dyson, Cassen & Visaria, 2005). The original variable assignments are shown in Table 1.

Table 1. Measurement Standards for Raw Variables

Variable type	Measurement Dimension		Measurement Metrics	Data Source
Conditional Variables	Economic Factors	Economic Development	Per capita regional gross domestic product (yuan) (GDP)	Fifth, sixth, and seventh population census data
		Educational Resources	Average years of education (AYE)	
		Infrastructure	Per capita housing construction area (m^2 people) (RFA)	
	Demographic Factors	Fertility Potential	Proportion of women aged 15-49 of childbearing age (%) (WCA)	
		Social Interaction	Population density (permanent population/land area) (PD)	
	Environmental Factors	Air Pollution	PM2.5 (g/m^2)	
Outcome Variable		Proportion of children	Proportion of children aged 0-14 (%) (PCA)	

3.4. Data Calibration

Prior to conducting necessity and sufficiency analyzes, both the condition and outcome variables must be calibrated. At the city level, clear external benchmarks for defining high or non-high levels of economic, demographic, and environmental conditions are often lacking. Consequently, as the assessment of child population share and low fertility trends relies on relative comparisons across the sample, this study employs a sample-based relative positioning approach for calibration (Alex, 2022).

Specifically, we utilize the direct calibration method, setting the 95th, 50th, and 5th percentiles of the sample distributions for each variable as the anchors for full membership, crossover, and full non-membership, respectively (Brauner-Otto, 2017). The resulting calibration anchors are presented in Table 2. Following established practice (Chu et al., 2022; Alex,2022; Brauner-Otto, 2017), the maximum value for each indicator is set to 1 and the minimum to 0, with data

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subsequently transformed to a relative positional value between 0 and 1 using the following formula:

$$P_i = (X_i - X_{min})/(X_{max} - X_{min}) \quad (1)$$

Table 2. Calibration Anchors

Measurement Indicator	Calibration Anchors (5th Census)			Calibration Anchors (6th Census)			Calibration Anchors (7th Census)		
	Full Membership	Crossover	Full Non-membership	Full Membership	Crossover	Full Non-membership	Full Membership	Crossover	Full Non-membership
GDP	23749.35	6422.50	2481.55	74979.10	27218.50	12195.90	132707.50	54619.50	29871.05
AYE	9.01	7.65	6.55	10.59	8.92	7.82	11.01	9.22	8.24
RFA	33.53	21.37	15.32	41.59	30.70	20.89	54.27	41.73	31.83
WCA	31.17	28.04	24.89	31.28	28.29	25.57	26.46	21.82	19.80
PD	841.20	330.00	56.37	957.14	355.54	57.11	1460.91	331.51	53.40
PM2.5	58.47	35.11	22.22	74.92	42.64	26.28	50.62	28.98	19.14
PCA	30.92	22.62	16.30	24.03	16.32	10.13	25.43	17.36	10.45

4. Research Results

4.1. Analysis of Necessary Conditions

The Necessary Condition Analysis (NCA) method identifies necessary conditions by examining the effect size and statistical significance of antecedent variables, with the bottleneck level technique further quantifying the required level of these conditions. The effect size, which ranges from 0 to 1, indicates a stronger necessity as it approaches 1. The statistical significance of these necessary conditions is assessed using a permutation test based on Monte Carlo simulation (Cooper et al., 2016). Furthermore, NCA provides two estimation techniques—Ceiling Regression (CR) and Ceiling Envelopment (CE)—which are suited for handling continuous and discrete variables, respectively.

Table 3. NCA: Analysis of Necessary Conditions for Individual Factors

Antecedent Condition	Method	2000		2010		2020	
		Effect Size (d)	p-value	Effect Size (d)	p-value	Effect Size (d)	p-value
GDP	CR	0.000	1.000	0.000	1.000	0.000	1.000
	CE	0.000	1.000	0.000	1.000	0.000	1.000
AYE	CR	0.000	1.000	0.000	1.000	0.000	1.000
	CE	0.000	1.000	0.000	1.000	0.000	1.000
RFA	CR	0.000	1.000	0.000	1.000	0.000	1.000
	CE	0.000	1.000	0.000	1.000	0.000	1.000
WCA	CR	0.000	1.000	0.000	1.000	0.000	1.000
	CE	0.000	1.000	0.000	1.000	0.000	1.000
PD	CR	0.054	0.506	0.054	0.530	0.054	0.403
	CE	0.109	0.506	0.109	0.530	0.109	0.403
PM2.5	CR	0.054	0.446	0.054	0.532	0.054	0.475
	CE	0.109	0.446	0.109	0.532	0.109	0.475
Note: (1) The analysis uses calibrated fuzzy-set membership scores. (2) The permutation test was employed with 10,000 resampling repetitions.							

Table 3 presents the results of the Necessary Condition Analysis (NCA) for individual antecedent conditions, reporting the effect sizes (d) and p-values derived from both the Ceiling

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Regression (CR) and Ceiling Envelopment (CE) methods. Following established convention, a condition is considered necessary if its effect size exceeds 0.1 and is statistically significant ($p < 0.05$) (Brauner-Otto et al., 2017). The analysis reveals that for a high child population share in 2000, 2010, and 2020, none of the six antecedent conditions—economic development, educational resources, infrastructure, fertility potential, social interaction, and air pollution—simultaneously met both the $d > 0.1$ and $p < 0.05$ criteria. This indicates that while individual variables may have an influence, none constituted a necessary condition for the outcome. Furthermore, the bottleneck level analysis for 2020, detailed in Table 4, identifies the minimum level (%) each antecedent condition must reach to achieve specific levels of the outcome. The results show that to achieve a 100% level of a high child population share, the required levels for the six antecedent variables are 0%, 0%, 0%, 0%, 33%, and 33%, respectively.

Table 4. Analysis of Single Condition Necessity Bottleneck Level (%) by NCA in 2020

PCA	GDP	AYE	RFA	WCA	PD	PM2.5
0	NN	NN	NN	NN	NN	NN
10	NN	NN	NN	NN	NN	NN
20	NN	NN	NN	NN	NN	NN
30	NN	NN	NN	NN	NN	NN
40	NN	NN	NN	NN	NN	NN
50	NN	NN	NN	NN	NN	NN
60	NN	NN	NN	NN	NN	NN
70	NN	NN	NN	NN	3.0	3.0
80	NN	NN	NN	NN	13.0	13.0
90	NN	NN	NN	NN	23.0	23.0
100	NN	NN	NN	NN	33.0	33.0
Note: (1) CR method, NN=unnecessary.						

This study also employs the fsQCA methodology to test the necessity of individual antecedent conditions within the economic, demographic, and environmental dimensions. As presented in Table 5, the consistency scores for the necessity of any single condition for a high/non-high child population share are all below the 0.9 threshold. This result aligns with the NCA findings, indicating that no single economic, demographic, or environmental factor constitutes a necessary condition for the outcome. The consistency is calculated as follows:

$$\text{Consistency}(Y_i \leq X_i) = \frac{\sum(\min(X_i, Y_i))}{\sum(Y_i)} \quad (2)$$

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Table 5. Assessing Necessary Conditions in Multi-Stage fsQCA

Antecedent Condition	2000		2010		2020	
	Consistency	Coverage	Consistency	Coverage	Consistency	Coverage
GDP	0.70	0.70	0.68	0.69	0.72	0.73
~GDP	0.85	0.87	0.85	0.86	0.78	0.83
AYE	0.70	0.70	0.69	0.69	0.68	0.69
~AYE	0.83	0.86	0.85	0.87	0.84	0.88
RFA	0.74	0.74	0.76	0.76	0.81	0.82
~RFA	0.79	0.81	0.75	0.78	0.69	0.73
WCA	0.66	0.66	0.71	0.71	0.74	0.76
~WCA	0.89	0.91	0.82	0.84	0.77	0.80
PD	0.76	0.75	0.76	0.76	0.76	0.78
~PD	0.77	0.80	0.77	0.80	0.74	0.78
PM2.5	0.74	0.75	0.77	0.76	0.75	0.75
~PM2.5	0.77	0.79	0.74	0.77	0.75	0.80

4.2. Multi-stage fsQCA Analysis

The analysis first utilized the fsQCA software to generate a truth table, which enumerates all logically possible combinations of the antecedent conditions concerning a high child population share. Following established practices (Alex et al., 2022; Brauner-Otto et al., 2017), the consistency threshold was set at 0.8 and the frequency threshold at 1. A case was assigned to the outcome (TFR=1) if its Proportional Reduction in Inconsistency (PRI) consistency exceeded 0.8; otherwise, it was coded as 0 (TFR=0). Configurations that surpass these thresholds are considered sufficient for the outcome, with a higher case frequency indicating greater empirical relevance.

After standardizing the truth table, three solution types are typically derived: complex, parsimonious, and intermediate. The intermediate solution, which incorporates only plausible logical remainders, is preferred for interpreting conditional configurations as it balances complexity and simplicity (Haien, 2022). In line with the presentation standard proposed by Fiss and Ragin (Ragin, 2019; Fiss, 2011), the configurations leading to a high child population share are displayed in Table 7. Acknowledging causal asymmetry, this study employs a multi-stage fsQCA approach to analyze the configurations for both the presence and absence of a high child population share. However, due to space constraints, the following discussion details only the configurations for a high child population share (i.e., a less pronounced low-fertility trend).

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Table 6. Configurational Analysis of Pathways to a High Child Population Share

Condition	5th Census (2000)		6th Census (2010)			7th Census (2020)
Configuration	A1	A2	B1	B2	B3	C1
Economic Development	⨂		⊗	⊗	⊗	⊗
Educational Resources	⊗	⊗	⊗	⨂	⊗	⊗
Infrastructure	⊗	⊗		⊗	⊗	●
Fertility Potential	⊗	⊗	⨂			•
Social Interaction		●	⊗	●	⊗	•
Air Pollution		⊗			●	•
Consistency	0.98	0.99	0.95	0.99	0.99	0.98
Raw Coverage	0.64	0.5	0.71	0.56	0.55	0.49
Unique Coverage	0.15	0.01	0.13	0.007	0.005	0.49
Overall Solution Consistency	0.99		0.94			0.98
Overall Solution Coverage	0.65		0.77			0.49

Note: Among them, "*" represents and. ● = Core condition (presence); ⨂= Core condition (absence); • = Peripheral condition (presence), ⊗ = Peripheral condition (absence)

As presented in Table 7, each column depicts a distinct causal configuration sufficient for a high child population share. The consistency scores for all six configurations exceed the 0.9 threshold, confirming their sufficiency for the outcome. Furthermore, the high overall solution consistency also surpasses 0.9, demonstrating the analytical robustness and strong explanatory power of the identified pathways within the case sample. The following section provides a detailed interpretation of these configurations with illustrative case examples.

4.2.1. Traditional Maintenance Type

Around the year 2000, the child population structure exhibited characteristics of strong traditional path dependence. The defining feature of this period was the decisive role of traditional factors in sustaining a high child population share, manifested through two distinct configurational patterns. Configuration A1 (Restricted Economic Development Type) was prominent in less developed coastal regions like Zhanjiang and Shanwei. These areas, reliant on agriculture and marine fisheries, had per capita GDPs of only 6,034 CNY and 5,107 CNY respectively in 2000, substantially below the national average. This lagging economic development reinforced families' traditional reliance on labor, sustaining higher fertility rates. Consequently, the proportion of the population aged 0-14 in these two cities reached 34.68% and 37.62%, significantly exceeding the national average of 23.84%. Configuration A2 (Social Interaction-Oriented & Environmentally Friendly), observed in locations such as Guigang and Yulin, demonstrated an alternative maintenance mechanism. Dense kinship networks and active community support in these areas effectively compensated for deficiencies in educational resources and infrastructure. Coupled with generally superior air quality at the time, this social capital formed a functional substitute for the incomplete modernization of traditional support structures. Collectively, these two configurations confirm that, despite differing levels of economic development, traditional factors remained the dominant influence on a high child population share during this period.

4.2.2. Composite Propulsion Type

After 2010, the determinants of child population share demonstrated more complex causal mechanisms. Configuration B1 (Economically Restricted with Moderated Fertility) was observed in central cities like Handan and Kaifeng. According to the 2010 census, the

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proportion of the population aged 0-14 in these cities was 20.71% and 21.31%, respectively, significantly higher than the national average of 17.41%. This pattern reflects the persistence of traditional fertility norms, combined with a demographic structural effect: the out-migration of working-age adults (15-64) increased the relative statistical weight of the child population. Configuration B2 (Socially Driven with Educational Scarcity) was typified by cities like Shantou and Puyang. Shantou's child population share was 22.17%, markedly higher than the Guangdong provincial average of 16.89%. This illustrates how strong social interaction, embedded in regional culture, can sustain fertility levels even amidst lower educational resources. The emergence of Configuration B3 (Environmentally Pressured) holds particular alarm. In 2010, PM2.5 concentrations in Zhoukou and Shaoyang reached 68.71 and 44.11 $\mu g/m^3$, respectively, both exceeding the national average. Nevertheless, their child population shares remained relatively high at 23.84% and 21.39%, indicating a degree of resilience in traditional fertility models against the dual challenges of lagging economic development and environmental governance.

4.2.3. Facility-Driven Type

By 2020, infrastructure had emerged as a dominant factor shaping child population patterns. Configuration C1 (Infrastructure-Driven), exemplified by cities like Baoding and Anyang, demonstrates this logic. With urbanization rates of 57.1% and 53.0% respectively, coupled with relatively comprehensive infrastructure such as transportation networks, these cities established a material foundation for population settlement. Despite lacking strong economic and educational advantages and facing air pollution challenges, they maintained a substantial child population share. This outcome was supported by a relative abundance of women of childbearing age (approximately 23-25%) and active social interaction, facilitated by the foundational infrastructure. This configuration indicates that robust infrastructure can support population settlement and enhance social connectivity, thereby offsetting economic and environmental pressures to foster a higher child population share.

5. Conclusion

This study analyzed the linkage effects of economic, demographic, and environmental factors on low fertility trends from 2000 to 2020, yielding the following conclusions.

In the economic dimension, lagging economic development and a scarcity of educational resources persistently influenced a high child population share between 2000 and 2020. However, a significant shift occurred by 2020, with high infrastructure emerging as a new core condition. In economically underdeveloped regions, constrained educational resources often correlate with more conservative fertility attitudes. While improved infrastructure shifts family focus towards child-rearing quality, fertility decisions in these contexts remain concurrently shaped by economic compensation considerations.

In the demographic dimension, high social interaction consistently supported a high child population share from 2000 to 2010. Concurrently, the influence of fertility potential transitioned from low to high, further contributing to this outcome. The relaxation of the family planning policy resulted in a relatively larger cohort of women of childbearing age. Enhanced social support for this group is likely to promote childbearing intentions, while frequent social interactions continue to sustain a higher child population share.

In the environmental dimension, the impact of air pollution evolved over the study period. While its effect was relatively marginal in 2000, high air pollution became a significant inhibitory factor from 2010 to 2020. Nevertheless, in areas characterized by rapid economic development and high urbanization, superior employment opportunities and living conditions can counteract the negative effects of environmental pollution, leading families to still choose to have children in these locales.

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6. Discussion

Grounded in the "economy-population-environment" configurational framework, this study systematically identifies the complex pathways influencing China's child population share by integrating multi-stage fsQCA with NCA. A key finding is that no single economic, demographic, or environmental factor constitutes a necessary condition for a high child population share. This challenges the conclusions of studies rooted in traditional linear thinking, which often emphasize a single dominant factor (e.g., Becker, 1960; Aassve et al., 2021). Instead, the child population structure arises from synergistic and substitutive relationships among multiple factors, demonstrating distinct characteristics of configurational dependence. For instance, in regions with lagging economic and educational development, a high child population share is often sustained through functional complementarity with traditional beliefs and frequent social interaction—a finding that aligns with Xue's (2023) observation of persistent fertility resilience in economically underdeveloped areas.

Furthermore, the influence of economic development on the child population share exhibits a distinct dual nature. In less developed regions, traditional pronatalist norms continue to underpin a relatively high child population share. Conversely, in economically advanced areas, improved infrastructure and higher educational attainment, while not directly boosting fertility rates, establish a material foundation for prioritized childbearing and child-rearing. This finding not only corroborates the non-linear relationship between development levels and fertility intentions proposed by Yiannis (2020) and Hathi (2017) but also reveals a unique mechanism within the Chinese context: infrastructure has emerged as a core condition influencing the child population share since 2020, highlighting the pivotal role of public goods provision in shaping family fertility decisions during rapid urbanization.

Within the demographic dimension, the persistent positive effect of social interaction aligns with the findings of Chu et al. (2022), who demonstrated that high-density social networks facilitate the diffusion of fertility norms. Notably, the transition of the proportion of women of childbearing age from a non-core to a core necessary condition signals the initial efficacy of China's recent fertility policy adjustments and the development of its social support systems. This finding further substantiates the argument put forth by Yang et al. (2024) that childbearing intentions are profoundly shaped by institutional and community support, a relationship now corroborated within the configurational pathways identified in this study.

The influence of environmental factors, particularly air pollution, has gained increasing prominence over time, corroborating Acheampong et al.'s (2022) assertion that environmental quality constitutes a critical variable in residential and reproductive decision-making. In earlier developmental stages, survival needs predominated in family decisions, thereby limiting the impact of environmental concerns. However, as public environmental awareness and health expectations have risen, high pollution levels have evolved into a structural factor suppressing the child population share in certain regions. This evolution underscores the necessity of incorporating environmental health and quality of life as significant dimensions in the study of demographic change and long-term family planning.

Based on these findings, this study proposes the following policy recommendations. Formulating effective fertility support policies requires moving beyond single-factor, linear approaches and adopting multi-dimensional, systemic governance. Specifically, policymakers should: first, promote balanced development across economic growth, educational quality, and infrastructure to alleviate resource constraints faced by families during childbearing and child-rearing; second, strengthen social support for women of reproductive age and build child-friendly social networks and environments to enhance childbearing intentions; and third, integrate environmental governance and public health into the top-level design of population development, ensuring ecological safeguards for children's healthy growth through sustained air quality improvement and the optimization of urban and rural living environments.

References

[1] Aassve, A., Le Moglie, M., & Mencarini, L. (2021). Trust and fertility in uncertain times. Population Studies, 75(1), 19–36. https://doi.org/10.1080/00324728.2020.1742927

[2] Adda, J., Dustmann, C., & Stevens, K. (2017). The career costs of children. Journal of Political Economy, 125(2), 293–337.

[3] Alex O. Acheampong, Janet Dzator, Michael Dzator, et al. (2022). Unveiling the effect of transport infrastructure and technological innovation on economic growth, energy consumption and CO2 emissions. Technological Forecasting and Social Change, 182, 121843. https://doi.org/10.1016/j.techfore.2022.121843

[4] Becker, G. (1960). An economic analysis of fertility. In Demographic and economic change in developed countries (pp. 209–231). Princeton University Press.

[5] Bono, E. D., Weber, A., & Winter-Ebmer, R. (2015). Fertility and economic instability: the role of unemployment and job displacement. Journal of Population Economics, 28(2), 463–478.

[6] Brauner-Otto, S. R., & Axinn, W. G. (2017). Natural resource collection and desired family size: a longitudinal test of environment-population theories. Population and Environment, 38(4), 381–406. https://doi.org/10.1007/s11111-016-0267-6

[7] Cheng, H., Luo, W., Si, S., Xin, X., Peng, Z., Zhou, H., & Yu, Y. (2022). Global trends in total fertility rate and its relation to national wealth, life expectancy and female education. BMC Public Health, 22(1), 1346.

[8] Chu, N., Zhang, P., & Wu, X. (2022). Spatiotemporal evolution characteristics of urbanization and its coupling coordination degree in Russia - perspectives from the population, economy, society, and eco-environment. Environmental Science and Pollution Research, 29(40), 61334–61351. https://doi.org/10.1007/s11356-022-20215-z

[9] Cooper, B., & Glaesser, J. (2016). Qualitative comparative analysis, necessary conditions, and limited diversity: Some problematic consequences of Schneider and Wagemann's enhanced standard analysis. Field Methods, 28(3), 300–315. https://doi.org/10.1177/1525822X15598974

[10] Ding, H. (2022). What kinds of countries have better innovation performance?—A country-level fsQCA and NCA study. Journal of Innovation & Knowledge, 7(4), 100215. https://doi.org/10.1016/j.jik.2022.100215

[11] Dong, Y., Yang, T., Gao, D., et al. (2024). A review of fertility motivation measurement research. Population and Development, 30(6), 41–50.

[12] Du, Y., & Jia, L. (2017). Configuration perspective and qualitative comparative analysis (QCA): A new path for management research. Management World, (6), 155–167.

[13] Du, Y., Liu, Q., & Cheng, J. (2020). What kind of business environment ecosystem generates high urban entrepreneurial activity?—Based on institutional configuration analysis. Management World, 36(9), 141–155. https://doi.org/10.19744/j.cnki.11-1235/f.2020.0143

[14] Du, Y., Liu, Q., Chen, K., et al. (2022). Business environment ecology, total factor productivity, and multiple models of high-quality urban development—Configuration analysis based on a complex system perspective. Management World, 38(9), 127–145. https://doi.org/10.19744/j.cnki.11-1235/f.2022.0123

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202602_9(2).0020

[15] Dyson, T., Cassen, R., & Visaria, L. (2005). Twenty-first-century India: Population, economy, human development, and the environment. Foreign Affairs, 84(1), 196. https://doi.org/10.2307/20034259

[16] Fauser, B. C. J. M., Adamson, G. D., Boivin, J., Chambers, G. M., de Geyter, C., Dyer, S., & Board, A. t. C. R. (2024). Declining global fertility rates and the implications for family planning and family building: an IFFS consensus document based on a narrative review of the literature. Human Reproduction Update, 30(2), 153–173.

[17] Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in organization research. Academy of Management Journal, 54(2), 393–420.

[18] Gerland, P., Raftery, A. E., Ševčíková, H., et al. (2014). World population stabilization unlikely this century. Science, 346(6206), 234–237. https://doi.org/10.1126/science.1257469

[19] Hathi, P., Haque, S., Pant, L., et al. (2017). Place and child health: The interaction of population density and sanitation in developing countries. Demography, 54(1), 337–360. https://doi.org/10.1007/s13524-016-0538-y

[20] Kountouris, Y. (2020). Higher education and fertility: Evidence from reforms in Greece. Economics of Education Review, 79, 102059.

[21] Luci-Greulich, A., & Thévenon, O. (2013). The impact of family policies on fertility trends in developed countries. European Journal of Population, 29(4), 387–416.

[22] Qu, X., Qin, X., & Wang, X. (2023). Construction of frugal innovation path in the context of digital transformation: A study based on NCA and QCA. Sustainability, 15(3), 2158. https://doi.org/10.3390/su15032158

[23] Ragin, C. C. (2019). Redesigning social science research: Fuzzy sets and beyond. China Machine Press.

[24] Sato, R. (2008). Japan's "super-low fertility": Its causes and policy responses. Journal of Population Problems, (6), 10–24.

[25] Wang, W., Liu, F., & Hu, C. (2019). Fertility policy, optimization of population age structure, and economic growth. Economic Research, 54(1), 116–131.

[26] Xue, L., Zhen, H., & Wang, J. (2023). Economic development level, fertility policy, and fertility rate. Statistics and Decision, 39(15), 79–84. https://doi.org/10.13546/j.cnki.tjyjc.2023.15.014

[27] Yamada, M. (2020). Why did Japan's countermeasures against low birthrate fail? The real reasons why marriage and childbirth are avoided. Kobunsha.

[28] Yang, F., Guo, P., & Liu, J. (2024). The situation, influencing factors, and policy responses to non-marriage, infertility, and low fertility in China—Analysis of the main data from a special survey on non-marriage, infertility, and low fertility groups in China. Population Research, 48(2), 30–43.

[29] Yang, L., Liu, Z., & Yao, T. (2024). Research progress on the intergenerational transmission of fertility intentions. Economic Perspectives, (8), 145–160.

[30] Zhang, J., Wei, L., Deng, X., et al. (2022). Current status and reflections on fertility preservation in China. Journal of Assisted Reproduction and Genetics, 39(12), 2835–2845. https://doi.org/10.1007/s10815-022-02648-0