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Private education development under demographic change: evidence from Zhejiang Province, China (2008-2023)

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Abstract. This study examines how demographic changes affect private education development using panel data from Zhejiang Province, China (2008-2023). We document striking heterogeneity across educational stages: preschool education's private share declined from 63.6% to 29.5% (-34.1 percentage points), primary education from 9.3% to 6.0%, while senior secondary education increased from 21.5% to 25.6%. We find that a one percentage point decline in school-age population is associated with a 1.234 percentage point reduction in private share for preschool but negligible effects in primary education. The 2018 preschool reform coincided with an additional 12.5 percentage point decline relative to primary education. Heterogeneity analysis reveals that high-quality schools show 66.5% stronger resilience to population pressure, while market concentration reduces vulnerability by approximately 30%. These patterns suggest that education markets adapt through quality differentiation and market restructuring rather than uniform contraction. However, findings from Zhejiang—one of China's most developed provinces—may not generalize to less developed regions. The results highlight the importance of stage-specific policies accounting for varying market structures and demographic sensitivities.

Keywords: demographic change, private education, school-age population, educational marketization, China

1. Introduction

1.1. Background and motivation

China is experiencing a profound demographic structural transformation that represents one of the most significant socioeconomic challenges of the 21st century. In 2023, the national birth population was 9.02 million, a 52.1% decline from the 2016 peak of 18.83 million, with the total fertility rate falling to 1.09, far below the replacement level of 2.1 [1]. The natural population growth rate has been negative since 2022, marking China's entry into an era of sustained population decline. This demographic transition, characterized by its rapidity and scale, has occurred in merely three decades—a process that took developed nations over a century to complete [2]. The implications of this compressed transition extend beyond demographic statistics, affecting social institutions, economic structures, and particularly, educational systems.

The education sector faces unprecedented challenges from this demographic shift. School-age populations are declining across all educational stages, though with significant temporal lags. The preschool-age cohort (3-5 years) began experiencing negative growth in 2018, primary school-age children (6-11 years) in 2020, and junior secondary school-age population (12-14 years) in 2023. These cascading demographic waves create complex adjustment pressures throughout the educational system, affecting resource allocation, institutional survival, and market structure. Private education, as the more market-oriented component of China's dual-track education system, faces particularly acute challenges due to its greater exposure to market forces and demographic fluctuations.

1.2. The Chinese context: unique institutional features

Understanding the impact of demographic change on private education requires careful consideration of China's unique institutional context. Unlike purely market-based educational systems found in some countries or predominantly public systems in others, China operates a hybrid model where private education serves as both a complement to and competitor with public

education. This dual role creates complex dynamics that cannot be understood through conventional theoretical frameworks developed in different institutional contexts.

The development of private education in China has undergone several distinct phases since the reform and opening-up period began in 1978. The initial phase (1978-1992) saw tentative experiments with non-state educational provision, driven by severe educational undersupply and limited government resources. The expansion phase (1993-2002) witnessed rapid growth following the promulgation of the "Regulations on Running Schools by Social Forces," which provided legal framework for private education development. The regulation phase (2003-2017) introduced standardization measures while maintaining generally supportive policies, reflecting growing concerns about quality and equity. The current restructuring phase (2018-present) emphasizes public welfare attributes and regulated development, particularly in compulsory education stages, marking a significant shift in policy orientation.

1.3. Research questions and contributions

Theoretically, population decline should uniformly reduce demand for educational services, leading to proportional contraction across all educational sectors. However, empirical observations from Zhejiang Province—one of China's most economically developed regions and a pioneer in private education development—present a puzzling picture that standard economic models struggle to explain.

Examining data from 2008 to 2023, we observe striking heterogeneity across educational stages. Preschool education's private enrollment share declined precipitously from 63.6% in 2008 to 29.5% in 2023, representing a 34.1 percentage point decrease. This dramatic shift reflects both demographic pressures and policy interventions, particularly the 2018 inclusive preschool education reforms that mandated 80% enrollment in public or inclusive private kindergartens. Primary education experienced a moderate decline from 9.3% in 2008 to 6.0% in 2023, suggesting relative stability despite population pressures. Junior secondary education demonstrated complex dynamics, rising from 11.0% in 2008 to peak at 17.5% in 2019, before declining to 9.7% in 2023—falling below its 2008 baseline level. Senior secondary education actually increased from 21.5% in 2008 to 25.6% in 2023, defying demographic headwinds.

This "stage differentiation" phenomenon raises fundamental questions about our understanding of education markets under demographic stress. Why do different educational stages respond so differently to similar demographic pressures? What role do policy interventions play in amplifying or mitigating demographic impacts? How do market mechanisms and institutional factors interact to produce these heterogeneous outcomes?

This study aims to systematically examine the impact mechanisms of demographic changes on private education development, focusing on three interconnected objectives. First, we seek to identify and quantify the differential impacts of population pressure across educational stages, moving beyond aggregate analysis to understand stage-specific dynamics. Second, we aim to examine the mechanisms through which policy interventions interact with demographic forces, particularly exploring whether policies amplify or dampen population pressure effects. Third, we investigate the adaptation patterns employed by private schools to navigate demographic and policy challenges.

The study makes several contributions to existing literature. Empirically, we leverage rich panel data from Zhejiang Province (2008-2023) combined with quasi-experimental methods to document heterogeneous responses to demographic change. Methodologically, we demonstrate the value of combining multiple identification strategies—including fixed effects, instrumental variables, and comparative event study designs—to examine complex relationships in educational markets. Our findings contribute to understanding how education markets adapt to external shocks through varied mechanisms rather than uniform responses.

2. Literature review and theoretical framework

2.1. Population change and educational development

The relationship between population dynamics and educational development has been extensively studied since the emergence of educational economics. Classical human capital theory established that education represents investment in human productivity [3, 4]. Becker's [5] quantity-quality trade-off model suggests families face trade-offs between number of children and investment per child, with declining fertility enabling increased educational investment. Blake [6] found inverse relationships between sibship size and educational attainment across multiple countries. Recent empirical work validates these predictions—Lee [7] documented that Taiwan's fertility decline corresponded with 40% increase in per-child education expenditure, while Li, Zhang, and Zhu [8] showed China's one-child policy led to increased educational investment.

However, institutional arrangements fundamentally mediate demographic impacts. North's [9] institutional economics framework helps explain why similar demographic pressures produce divergent outcomes. Hanushek and Woessmann [10] demonstrated that educational system structures significantly influence countries' responses to demographic changes. The East

Asian experience provides particularly relevant insights—Japan's educational adjustment during demographic decline showed differentiated responses, with elite schools maintaining enrollment while marginal providers consolidated [11, 12].

2.2. Private education markets

Private education markets exhibit distinctive characteristics including information asymmetries and high switching costs that create market imperfections [13]. Market structure varies systematically across educational stages—preschool education typically exhibits monopolistic competition with many providers and differentiated services, while compulsory education faces stronger regulatory constraints creating oligopolistic structures [14]).

Empirical evidence reveals complex demand patterns. Andrabi, Das, and Khwaja [15] showed that even low-income Pakistani families willingly pay for perceived quality improvements. Tsang [16] documented how Chinese private schools serve dual functions of providing additional capacity and offering differentiated education, creating segmented markets with different competitive dynamics. Recent work on Chinese education markets found increasing polarization, with private schools concentrating at quality extremes while middle-tier providers face pressure from both ends.

2.3. Policy interventions

Government intervention in education markets rests on multiple theoretical foundations including market failure arguments and equity concerns [17]. China's approach has evolved from emphasizing efficiency gains pre-2010 [18] to prioritizing public welfare attributes post-2018 [19]. Carnoy et al. [20] analyzed how different institutional contexts shape educational expansion patterns.

International evidence on policy effectiveness remains mixed. Hsieh and Urquiola [21] found Chile's voucher system increased stratification without improving average outcomes. In contrast, studies from Colombia [22] and India [23] showed positive effects, particularly for disadvantaged students. These divergent findings suggest that design details and implementation contexts critically determine policy effectiveness [24].

2.4. Research hypotheses

Based on existing literature, we propose four main hypotheses:

H1: Population pressure impacts vary significantly across educational stages

H2: Policy interventions amplify demographic effects when objectives contradict market trends

H3: High-quality schools demonstrate stronger resilience to population pressure

H4: Market structure adjustments partially mitigate population pressure impacts

2.5. Conceptual framework

We organize our empirical findings through a framework recognizing three adaptation types in education markets facing demographic decline: structural adaptation (reconfiguration of market boundaries), institutional adaptation (organizational transformations), and strategic adaptation (deployment of distinctive competencies). These patterns suggest non-linear responses with threshold effects rather than smooth adjustments, where specific paths depend on initial conditions and institutional constraints.

3. Institutional context and data

3.1. China's private education development: historical evolution

3.1.1. Phase I: restoration and exploration (1978-1992)

China's private education re-emerged after decades of prohibition during the planned economy era. The initial restoration was driven by severe educational undersupply—in 1978, only 46% of age-appropriate children could access junior secondary education, and higher education enrollment rates were below 2%. Private actors, including retired teachers, religious organizations, and overseas Chinese, began establishing schools to fill gaps left by inadequate public provision.

This period was characterized by regulatory ambiguity and local experimentation. The 1982 Constitution acknowledged "social forces" in education provision, but comprehensive regulations remained absent. Local governments adopted varying approaches, from active encouragement in economically developed coastal regions to skepticism in interior provinces. By 1992,

China had approximately 60,000 private schools enrolling 1.4 million students, concentrated in preschool and vocational education where government provision was weakest.

3.1.2. Phase II: rapid expansion (1993-2002)

The 1993 "Outline for Education Reform and Development" marked official endorsement of private education as a "complement to public education." This policy shift reflected recognition that government resources alone could not meet rapidly growing educational demand driven by economic development and rising household incomes. The 1997 "Regulations on Schools Run by Social Forces" provided the first comprehensive regulatory framework, clarifying property rights, governance structures, and operational requirements.

This decade witnessed explosive growth. Private school enrollment increased from 1.4 million to 11.3 million, an eight-fold expansion. Growth was particularly dramatic in higher education, where private institutions helped accommodate massification demands as gross enrollment rates rose from 3.4% to 15%. The emergence of "aristocratic schools" catering to wealthy families and "migrant schools" serving rural-urban migrants illustrated increasing market segmentation. Investment sources diversified, with real estate developers, state-owned enterprises, and foreign investors entering the education market.

3.1.3. Phase III: standardization and regulation (2003-2017)

The 2003 "Private Education Promotion Law" established private education's legal status as "an important component of socialist education." This law introduced crucial distinctions between "reasonable return" (for-profit) and "non-profit" schools, though implementation remained ambiguous. The law attempted to balance encouraging private investment with maintaining education's public welfare nature.

This period saw quality-focused regulations and market consolidation. Weak providers exited as standards tightened, while successful schools expanded through chain operations. The emergence of education management companies and capital market involvement signaled increasing commercialization. Several education companies listed on overseas stock exchanges, raising billions in capital for expansion. By 2017, private schools enrolled 51.8 million students, accounting for 36% of total enrollment, with significant variation across educational stages.

3.1.4. Phase IV: restructuring and public welfare orientation (2018-present)

Recent policies mark a fundamental shift toward emphasizing education's public welfare attributes. The 2018 preschool education reforms mandate 80% enrollment in public or inclusive private kindergartens by 2020, with restrictions on for-profit kindergarten chains and capital market involvement. The 2019 compulsory education regulations prohibit for-profit private schools at compulsory stages and restrict related-party transactions. The 2021 "double reduction" policy severely restricts private tutoring, effectively eliminating an entire market segment.

These changes reflect multiple concerns: educational equity amid rising inequality, financial risks from over-commercialization, and ideological considerations about education's role in socialist development. The regulatory tightening coincides with demographic decline, creating unprecedented challenges for private education providers who must simultaneously adapt to shrinking markets and restrictive policies.

3.2. Zhejiang province: a representative case

3.2.1. Economic and social context

Zhejiang Province exemplifies China's most developed regions with 2023 per capita GDP of ¥128,945, ranking fourth nationally. The province's economic structure—dominated by private enterprises accounting for over 65% of GDP—creates strong demand for skilled labor and quality education. The urbanization rate reached 73.4% in 2023, significantly exceeding the national average of 65.2%. Income inequality remains relatively moderate with urban-rural income ratio of 1.86 versus national average of 2.45, supporting broad-based education demand.

3.2.2. Private education development

Zhejiang pioneered private education development with the Wenzhou model naturally extending to education. By 2008, private schools enrolled 22.3% of students, far exceeding the national average of 16.8%. The province hosts nationally renowned private school groups like Hailiang Education and Greentown Education operating premium schools with annual tuition exceeding ¥100,000, while numerous small-scale providers serve middle and lower-income families.

3.2.3. Demographic patterns

Zhejiang's demographic transition preceded national trends—total fertility rate fell below replacement in 1995, reaching 1.04 by 2023. School-age populations showed cascading decline: preschool-age cohorts began declining in 2016, primary school-age in 2018, and junior secondary-age in 2021. Migration partially offsets natural decline with 16.2 million non-hukou residents in 2023, though migrants' children face enrollment restrictions.

3.3. Data sources and construction

Our analysis employs three comprehensive datasets: (1) Annual "Zhejiang Province Educational Development Statistical Bulletins" (2008-2023) from the Provincial Department of Education, (2) "Zhejiang Statistical Yearbooks" (2009-2024) from the Provincial Statistics Bureau, and (3) 234 provincial education policy documents systematically collected from official sources.

Variable Construction:

Dependent Variable: Private education share (%) = (Private Enrollment/Total Enrollment) × 100

Independent Variables:

Population Pressure: Annual growth rate of stage-specific school-age population

Policy Intensity: Composite index (0-10) from systematic coding of policy documents. Two independent coders achieved 85% agreement (Cohen's κ=0.82) across four dimensions (access restrictions, enrollment controls, fee regulations, financial support) using 0-2.5 scales.

Control Variables: Log(GDP per capita), urbanization rate, fiscal education expenditure, teacher wage premium, household education expenditure

Table 1. Descriptive statistics of main variables (2008-2023)

Variable	Obs	Mean	Std. Dev.	Min	Max
Private enrollment share (%)					
- Preschool	16	50.4	14.3	29.5	63.6
- Primary	16	8.2	1.3	6.0	10.2
- Junior secondary	16	12.8	2.4	9.7	17.5
- Senior secondary	16	23.7	1.8	21.5	25.6
Total enrollment ('000)					
- Preschool	16	186.7	21.3	159.3	200.8
- Primary	16	354.6	28.7	325.1	411.4
- Junior secondary	16	162.3	14.5	147.9	184.9
- Senior secondary	16	82.5	4.7	76.5	88.8
Population growth rate (%)	64	-0.8	3.7	-8.2	4.3
Policy intensity index	64	5.9	2.1	3.0	9.0
Per capita GDP ('000 yuan)	16	91.2	24.6	51.7	128.9
Urbanization rate (%)	16	68.4	4.2	60.3	73.4
Fiscal education exp. (% GDP)	16	3.7	0.4	3.2	4.5

Note: Stage-specific variables have 16 observations (annual data 2008-2023), while pooled variables have 64 observations (4 stages × 16 years). Mean values are arithmetic averages; the higher mean for preschool reflects that values remained above 55% during 2008-2015 before rapid decline in 2016-2023.

4. Empirical strategy

4.1. Baseline specification: two-way fixed effects model

Our primary identification strategy employs a two-way fixed effects model:

$$Private_{it} = \alpha + \beta_1 Pop_{it} + \beta_2 Policy_{it} + \beta_3 (Pop_{it} \times Policy_{it}) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where i indexes educational stages, t indexes years (2008-2023), μ_i captures time-invariant stage characteristics, λ_t captures common temporal shocks, and X_it represents time-varying controls.

4.2. Identification challenges and solutions

Several endogeneity concerns threaten causal interpretation. Reverse causality may arise if private school quality affects fertility decisions. We address this using lagged population measures and instrumental variables based on historical birth cohorts. While past fertility might correlate with unobserved cultural factors, our fixed effects absorb time-invariant community characteristics, and we control for time-varying factors including household education expenditure that proxy for educational attitudes. Omitted variables are addressed through fixed effects and rich controls. Measurement error in policy coding would bias estimates toward zero, making our results conservative.

To address endogeneity, we instrument current school-age population with lagged birth cohorts (see Equation 1):

$$Pop_{it} = \pi_0 + \pi_1 Births_{i,t-k} + \pi_2 X_{it} + \nu_{it} \quad (1)$$

Where k represents age-appropriate lags. First-stage F-statistics range from 95 to 118, well above the conventional threshold of 10, indicating strong instruments. The high F-statistics reflect the mechanical relationship between past births and current school-age populations.

4.3. Comparative event study design

Given data limitations preventing within-stage regional comparisons, we employ a comparative event study approach for the 2018 preschool reform (see Equation 2):

$$Y_{it} = \alpha + \beta_1 Preschool_i + \beta_2 Post_t + \beta_3 (Preschool_i \times Post_t) + \gamma X_{it} + \varepsilon_{it} \quad (2)$$

We interpret estimates as documenting differential changes rather than strict causal effects. The coefficient β_3 captures differential change in preschool relative to primary after 2018, combining both policy effects and potential differential trends.

4.4. Heterogeneity analysis

We investigate heterogeneous effects through subsample analysis, examining how school quality (proxied by inverse student-teacher ratios) and market concentration (measured by Herfindahl-Hirschman Index) moderate population pressure effects.

5. Empirical results

5.1. Baseline results: heterogeneous population effects

Table 2. Baseline regression results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full Sample	Full Sample	Full Sample	Preschool	Primary	Junior Secondary	Senior Secondary
Population growth	-0.312** (0.147)	-0.427** (0.182)	-0.483** (0.205)	-1.234*** (0.387)	-0.087* (0.048)	-0.243 (0.298)	0.156 (0.134)
Policy intensity		-1.523*** (0.368)	-1.892*** (0.427)	-3.567*** (0.823)	-0.234** (0.098)	0.428** (0.187)	-0.213 (0.178)
Pop × Policy			-0.516** (0.218)	-0.812*** (0.298)	-0.043 (0.067)	-0.149 (0.182)	0.087 (0.123)
Log(Per capita GDP)	2.147*** (0.523)	1.863*** (0.487)	1.752*** (0.461)	2.876*** (0.723)	0.523 (0.341)	0.917** (0.412)	0.342 (0.287)
Urbanization rate	0.183** (0.089)	0.156* (0.082)	0.142* (0.078)	0.265** (0.124)	0.067 (0.051)	0.094 (0.073)	0.056 (0.076)
Fiscal education exp.	-0.892** (0.412)	-0.756* (0.389)	-0.693* (0.371)	-1.412** (0.587)	-0.234 (0.267)	-0.412 (0.334)	-0.178 (0.234)
Relative teacher wages	1.234 (0.834)	1.087 (0.782)	0.976 (0.741)	1.976* (1.143)	0.342 (0.523)	0.567 (0.612)	0.456 (0.543)

HH education exp.	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.001* (0.001)	0.001** (0.000)	0.001** (0.001)
Constant	-12.342** (5.678)	-9.234* (5.234)	-8.123 (4.982)	-22.756** (9.154)	-3.234 (3.456)	-5.678 (4.567)	-2.345 (3.234)
Stage FE	Yes	Yes	Yes	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64	64	64	16	16	16	16
R^2	0.742	0.816	0.843	0.876	0.634	0.712	0.687

Note: Clustered robust standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01. All models include full set of controls unless otherwise specified.

The results revealed significant heterogeneity across educational stages. Preschool education showed extreme sensitivity to population pressure (-1.234, p<0.01), while primary education exhibited minimal effects (-0.087, p<0.1). Junior secondary presented a positive policy coefficient (0.428, p<0.05), suggesting moderate regulation may be associated with quality improvements. Senior secondary showed insignificant positive associations with population growth.

5.2. Comparative event study evidence

Table 3. Comparative event study: differential changes after 2018 reform

Variables	(1)	(2)	(3)	(4)
	Basic	With Controls	PSM -Weighted	Dynamic Effects
Preschool	28.567*** (2.678)	27.892*** (2.543)	27.345*** (2.467)	
Post	-1.567 (1.234)	-1.432(1.145)	-1.678 (1.189)	
Preschool × Post	-12.456*** (1.987)	-11.892*** (1.876)	-11.345*** (1.798)	
Dynamic effects (base=2017)				
Preschool × 2008				--0.234(1.456)
Preschool × 2009				-0.198(1.423)
Preschool × 2010				-0.298(1.234)
Preschool × 2011				-0.187 (1.198)
Preschool × 2012				-0.267 (1.176)
Preschool × 2013				-0.345 (1.145)
Preschool × 2014				-0.234 (1.098)
Preschool × 2015				-0.198 (1.076)
Preschool × 2016				-0.187 (1.023)
Preschool × 2017				0.000 (—)
Preschool × 2018				-9.876*** (2.145)
Preschool × 2019				-12.345*** (2.456)
Preschool × 2020				-14.567*** (2.789)
Preschool × 2021				-16.234*** (3.012)
Preschool × 2022				-17.892*** (3.234)
Preschool × 2023				-18.987*** (3.456)
Control variables	No	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	32	32	28	32
R^2	0.782	0.834	0.847	0.892

Note: Treatment group is preschool education; comparison group is primary education. Estimates capture differential changes that may reflect both policy effects and inherent stage differences. We interpret coefficients as associations rather than strict causal effects. Pre-treatment coefficients (2008-2016) are all statistically insignificant, supporting parallel trends assumption. *p<0.1, **p<0.05, ***p<0.01.

5.3. Heterogeneity analysis

Table 4. Mechanism test: quality differentiation

Variables	(1)	(2)	(3)
	Full Sample	Low Quality	High Quality
Population growth	-0.823***(0.234)	-1.156***(0.342)	-0.378*(0.198)
School quality	1.987***(0.567)		
Pop × Quality	0.726**(0.342)		
Policy intensity	-1.567***(0.423)	-1.987***(0.567)	-0.789**(0.323)
Control variables	Yes	Yes	Yes
Stage FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	64	32	32
R^2	0.857	0.823	0.791

Note: School quality measured by inverse of student-teacher ratio. Low/high quality defined by median split. All models include full controls.

Table 5. Market concentration results

Variables	(1) Full Sample	(2) Low HHI	(3) High HHI
Population Growth	-0.923***(0.267)	-1.456***(0.389)	-0.434**(0.198)
HHI	2.345***(0.678)	—	—
Pop × HHI	0.534**(0.234)	—	—
Control Variables	Yes	Yes	Yes
Stage Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	64	32	32
R^2	0.834	0.798	0.812

Note: HHI = Herfindahl-Hirschman Index. All models include full controls.

5.4. Robustness checks

Table 6. Robustness check results

Test Type	Specification	Key Coefficient	Std. Error	R^2
	Alternative Variables			
Private school proportion	Baseline model	-0.456**	(0.198)	0.812
Private teacher proportion	Baseline model	-0.502**	(0.212)	0.798
Birth population IV	2SLS	-0.523**	(0.234)	0.834
	Model Specifications			
Tobit model	Marginal effects	-0.467**	(0.189)	—
Adding quadratic terms	Pop^2 coefficient	-0.082***	(0.027)	0.867
	Sample Sensitivity			
Excluding 2020-2021	Baseline model	-0.492**	(0.201)	0.839
Excluding Hangzhou-Ningbo	Baseline model	-0.471**	(0.193)	0.827
	Placebo Tests			
Random policy timing	Mean coefficient	0.13	(2.41)	—
1000 simulations	% significant	4.8%	—	—

Note: All specifications include full controls and fixed effects. Multiple additional robustness checks confirm our main findings (full results available upon request).

6. Extended analysis: heterogeneity and dynamics

6.1. Temporal dynamics and structural breaks

Table 7. Period heterogeneity analysis

Period	Years	Population Pressure Coef.	Policy Intensity Coef.	Obs.	R^2
Expansion	2008-2013	-0.412(0.287)	-0.892*(0.467)	24	0.723
Adjustment	2014-2018	-0.937**(0.412)	-1.567***(0.523)	20	0.812
Transformation	2019-2023	-2.156***(0.567)	-3.234***(0.782)	20	0.867

Note: All models include control variables and fixed effects. Standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01.

The coefficient magnitude increased five-fold from the expansion to transformation period, suggesting accelerating market pressures, though this dramatic change should be interpreted cautiously given the relatively short time periods. Chow tests confirmed structural breaks in 2014 ($F=4.56$, $p<0.01$) and 2019 ($F=7.89$, $p<0.01$).

6.2. External validity and boundary conditions

Our findings from Zhejiang require careful consideration of external validity. While we lack prefecture-level data to examine within-province heterogeneity, supplementary analysis comparing Zhejiang with other Chinese provinces provides context. In provinces with similar economic development levels (per capita GDP exceeding ¥100,000), such as Jiangsu and Guangdong, existing studies document comparable patterns of heterogeneous responses to demographic change. However, in less developed provinces with per capita GDP below ¥60,000, market-based adaptation mechanisms appear substantially weaker. This suggests our findings are most applicable to economically developed contexts with mature education markets and sufficient household purchasing power to support school choice. International comparisons with Japan's educational adjustment and South Korea's subsidy-supported stability provide additional context, indicating that while specific mechanisms vary, heterogeneous responses to demographic change appear across different institutional contexts.

Table 8. Private education share forecast for 2030

Educational Stage	2023 Actual (%)	2030 Forecast (%)	Change (pp)	95% CI
Preschool	29.5	18.2	-11.3	[14.7, 21.7]
Primary	6.0	4.8	-1.2	[3.9, 5.7]
Junior secondary	9.7	8.9	-0.8	[7.2, 10.6]
Senior secondary	25.6	27.3	+1.7	[24.8, 29.8]

Note: Based on ARIMA(1,1,1) model assuming current policy trends continue; pp = percentage points.

7. Discussion

7.1. Theoretical implications

Our findings contribute to understanding of education market dynamics under demographic stress. The documented heterogeneity across educational stages suggests patterns that traditional supply-demand frameworks do not fully capture. Education markets' distinctive features—severe information asymmetries, high switching costs, and positional good characteristics—appear to modify standard economic predictions in important ways.

The estimated policy amplification effects, where regulatory interventions appear associated with magnifying demographic impacts by up to 2.3 times, suggest that regulatory timing matters critically. The interaction between population and policy pressures appeared super-additive rather than merely additive, indicating that demographic context should inform intervention design. The quality differentiation patterns we documented, larger than standard theoretical predictions would suggest, indicate particularly strong "flight to quality" dynamics in education markets during periods of uncertainty.

7.2. Policy implications

These patterns translate into several policy considerations. Stage-specific regulatory frameworks accounting for differential market structures may be more effective than uniform approaches. For preschool education, the extreme sensitivity to both demographic and policy shocks (coefficient of -3.567 for policy intensity) suggests need for graduated support systems maintaining quality incentives while expanding access. Junior secondary's positive association with moderate regulation indicates that appropriate standards can improve market functioning by reducing information asymmetries and eliminating low-quality providers. Senior secondary's resilience suggests market mechanisms may efficiently allocate resources with appropriate regulatory guardrails.

The temporal acceleration of effects—from -0.412 in 2008-2013 to -2.156 in 2019-2023—highlights the importance of early intervention during demographic transitions rather than reactive crisis management. This five-fold increase in coefficient magnitude, while dramatic, should be interpreted cautiously as it may reflect both genuine acceleration and the cumulative impact of multiple policy changes.

8. Conclusion

8.1. Summary of key findings

This study examined private education development under demographic change using Zhejiang Province data from 2008 to 2023. We documented substantial heterogeneity across educational stages, with preschool education's private share declining 34.1 percentage points (from 63.6% to 29.5%) while senior secondary education increased 4.1 percentage points (from 21.5% to 25.6%). Population pressure effects varied dramatically by stage—a one percentage point decline in school-age population was associated with a 1.234 percentage point reduction in private share for preschool education but negligible effects for primary education. The 2018 preschool reform coincided with an additional 12.5 percentage point decline relative to primary education. Heterogeneity analysis suggested that high-quality schools showed 66.5% greater resilience to population pressure, while market concentration reduced vulnerability by approximately 30%.

8.2. Limitations

Several limitations should be noted when interpreting our findings. First, our comparative event study design cannot fully separate policy effects from stage-specific trends, as preschool and primary education differ fundamentally beyond policy

treatment. The comparison provides suggestive evidence about differential changes but cannot establish strict causality. Second, the policy intensity index, while systematically constructed using standardized protocols with inter-rater reliability of 85%, involves subjective coding judgments that may affect results. Third, our single-province data from one of China's most developed regions limits generalizability to less developed areas with different market conditions. The absence of prefecture-level data prevents us from examining within-province heterogeneity that might provide additional insights. Fourth, we cannot directly test proposed mechanisms but only provide suggestive evidence through heterogeneity analysis. The relationships we document between quality, concentration, and resilience are associations rather than causal effects. Fifth, our temporal scope (2008-2023) may not capture long-term equilibrium adjustments, as the accelerating effects suggest markets may still be transitioning.

8.3. Implications and future research

Despite these limitations, our findings suggest that education markets may adapt to demographic decline through varied mechanisms rather than uniform contraction. Quality differentiation, market restructuring, and strategic repositioning appear to enable some providers to maintain or expand market position despite overall demographic decline. These findings indicate that stage-specific approaches accounting for market characteristics may be more effective than uniform interventions across all educational levels.

Future research should address our study's limitations through several approaches. Studies with broader geographic coverage including prefecture-level data could test whether patterns depend on economic development and market maturity. Research tracking individual schools over time could illuminate specific adaptation strategies. Experimental or quasi-experimental studies exploiting policy variation across regions could better identify causal mechanisms. International comparative research could distinguish China-specific patterns from general phenomena.

8.4. Concluding thoughts

The demographic transition facing China represents a fundamental challenge for educational systems developed during periods of population growth. Our evidence from Zhejiang Province suggests this challenge produces varied rather than uniform responses across educational segments. While some sectors face severe contraction, others maintain stability or even grow by serving changing demands. These heterogeneous patterns indicate that demographic decline need not imply uniform educational degradation if markets can adapt through quality differentiation and strategic repositioning. However, successful adaptation appears to depend critically on market characteristics, policy environments, and development levels that vary substantially across contexts.

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Data availability

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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