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Factors influencing the willingness to delay retirement among university teachers in Sichuan, China

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ABSTRACT

The strategic use of highly educated older people, often called the "silver-haired workforce," is gaining importance in China due to rapid population aging and the nationwide introduction of delayed retirement policies. This study applies structural equation modeling (SEM) together with follow-up interviews, using data from university teachers in different institutions across Sichuan Province, China, to examine the main factors that shape their willingness to delay retirement. The results show: (1) Policy tools have a strong positive effect on willingness to delay retirement through a three-part mechanism (mandatory constraints, incentives, and soft regulation), making them the most important factor; (2) The occupational environment has a weaker direct effect, but its influence becomes stronger when mediated by psychological factors, showing hidden effects, delayed responses, and reduced impact over time; (3) The mediating role of psychological mechanisms differs across pathways because explicit policy tools directly affect perception, while the occupational environment influences willingness through cognitive processing. These findings offer practical evidence for education authorities and university leaders to improve retirement policies and faculty management strategies.

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1. Introduction

The phenomenon of global population ageing has become a major challenge for contemporary society. According to the United Nations, the global population aged 60 and overreached 1.05 billion in 2020, and it is expected to exceed 2.1 billion in 2050 (Rademeyer and Maharaj, 2020). China, as the most populous country, is particularly affected by this demographic shift, which is characterized by an ageing population. The proportion of individuals aged 65 and over in China has increased from 8.9% in 2010 to 14.9% in 2022, indicating that China has officially entered a phase of significant demographic ageing. At the regional level, Sichuan Province serves as a representative case of China's aging population dynamics. In 2022, its population aged 65 and above reached 18.13%, exceeding the national average by 3.23%. Notably, 17 of the province's 21 prefecture-level cities have entered a deep aging society status, ranking first nationally. In response to demographic aging, the strategic development of a "silver-haired workforce" has emerged as a critical national priority for addressing demographic challenges. Delayed retirement policies implemented by developed countries such as Germany and Sweden serve as internationally recognized reform measures (Hess, 2018; Sundström et al., 2020). These policies are set to be fully implemented in China by 2025, holding particular significance for regions with severe aging issues like Sichuan Province.

In the study of delayed retirement policy, its influence mechanism has become an interdisciplinary research hotspot. The four-factor model of "economic security, family responsibility, working conditions, and individual attitudes" proposed by Flynn (2010) has established a foundational framework for subsequent research. Hess (2018) and Mäcken et al. (2019) further elucidate the moderating role of skill level, job differences, and work pressure. The study demonstrates that individual decision-making patterns can be reshaped by altering the boundary conditions of policy responses. Notably, these mechanisms ultimately converge on a core variable—willingness to delay retirement, defined as an individual's willingness to continue labor force participation within the policy framework. This

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construction not only captures policy-individual interactions but also serves as a key predictor of retirement behavior. Moreover, significant variations emerge across populations regarding delayed retirement intention. For instance, studies on civil servants and corporate employees reveal complex interplays between external policy environments, occupational conditions, and personal cognition, demonstrating population-specific differences in influential factors, effect sizes, and underlying mechanisms. Meanwhile, other studies have emphasized the mediating role of economic self-efficacy in social support and in the retirement decision-making of employees, demonstrating the importance of individual psychological mechanisms (Olajide et al., 2023). Collectively, these findings underscore the heterogeneity and multilevel nature of the factors influencing the decision to delay retirement, highlighting substantial disparities across demographic groups, cultures, and regions. However, in China, the delayed retirement policy is still in the early stage of implementation, and there is still an obvious shortcoming in systematic research on the retirement willingness of university teachers. This is coupled with the fact that Chinese universities are currently undergoing a critical period of digital transformation. The advent of emerging educational models, such as smart education and virtual simulation, has reshaped the role of teachers, the content of their work, and the professional pressures they face (Qorraj and Kaçaniku 2023). The multi-participant nature of education (including students, parents, society, and school management) has made the working environment of teachers more complex and volatile, and these profound changes have undoubtedly had a significant impact on teachers' willingness to retire.

Therefore, this study constructs a Policy-Occupation-Psychological Mechanism analysis framework based on the Theory of Planned Behavior (TPB) and Social Cognitive Theory (SCT). Taking university teachers in Sichuan Province, China, as the research sample, it specifically examines how policy instruments and occupational environments influence teachers' willingness to delay retirement through psychological mechanisms in the context of digital transformation. This study aims to provide decision-makers with a scientific foundation for designing retirement policies, optimize the design of retirement policies, and alleviate the pressure of social aging. It also provides education administrators with new perspectives on human resource allocation, which will help enhance teachers' professional satisfaction and promote the sustainable development of education.

2. Literature review

2.1. Theory

Integrating SCT and the TPB provides an interdisciplinary framework for analyzing the decision-making mechanisms behind teachers' delayed retirement. SCT, grounded in triadic reciprocal determinism, emphasizes the dynamic interplay between personal cognition, behavior, and environment, with observational learning, social influence, and self-efficacy serving as key behavioral shaping mechanisms. TPB predicts behavioral intention through psychological mechanisms—attitude, subjective norms, and perceived behavioral control (Ajzen, 1991). The two theories exhibit strong complementarity in explaining environmental influences on behavior.

Specifically, SCT's observational learning mechanism elucidates how teachers internalize subjective norms by modeling reference groups (e.g., peers, administrators). Social influence further clarifies the origins of normative pressures within TPB. Additionally, self-efficacy emphasizes an individual's subjective judgment of their ability to perform a certain behavior, while perceived behavioral control is more general, encompassing both this confidence in ability and an individual's perception of external conditions, resources, and environmental constraints, which together influence an individual's assessment of their ability to continue in their career.

In summary, the integration of SCT and TPB provides a comprehensive theoretical framework for analyzing how the external environment affects teachers' psychological mechanisms and ultimately influences their decision-making process of delaying retirement.

2.2. Policy instruments and willingness to delay retirement

Policy instruments serve as the core means of achieving public governance objectives. Their effectiveness is influenced not only by the type of tool but also by the implementation context and the characteristics of the target group (Vedung, 1998; Howlett, 2023). Moreover, policymakers' behavioral logic, the receptiveness of target groups, and the interactive dynamics during policy implementation must also be considered (Howlett et al., 2020). The present study is predicated on 14 empirical studies. It categorizes policy instruments into three dimensions: mandatory measures, incentive measures, and soft regulation measures. And analyzes in depth the mechanism of the differential impact of different instruments on teachers' delayed retirement decisions.

First, mandatory measures, as direct instruments of governmental intervention, demarcate behavioral boundaries via regulatory frameworks, administrative mandates, or standardized protocols, with their efficacy exhibiting pronounced context dependency. On the one hand, Li et al. (2020) demonstrated that mandatory policies can strengthen public perceptions of normative legitimacy and catalyze voluntary adherence. Lu et al. (2024) and Hao and Xu (2023) also verified the promotional effect of economic penalties and other measures on behavioral compliance. On the other

hand, mandatory measures that disregard target behavioral nuances, implementation barriers, or psychological responses may precipitate reactance or outright resistance within the affected population (Olejniczak et al., 2020). Although the dual effect of mandatory measures on residents' behavior has been confirmed, the specific impact mechanism on university teachers remains to be explored in depth.

Unlike mandatory measures, incentives have been shown to influence people's behavioral intentions through the provision of material or non-material rewards. However, the efficacy of these incentives is subject to variation based on contextual and group-specific factors. Nguyen et al. (2024) found that team incentives can significantly improve team members' motivation and work performance. Javaudin et al. (2024) further found that personalized incentives are more effective than standardized incentives and are more suited to individual differences. However, Ting et al. (2019) also pointed out that single material incentives are difficult to form sustained behavioral changes, and their incentive effects are easily constrained by the characteristics of the target group. There is still a lack of systematic verification of the effectiveness of incentive strategies for college teachers.

Finally, soft regulation measures, as the third type of policy tool, emphasize dissemination, emotional mobilization, and cultural identity as their core elements, guiding behavioral change through subtle and gradual means (Boschetti and Poli, 2021). Therefore, by recalibrating attitude and subjective norms, such policies can reshape teachers' professional identity, transmuting mandatory retirement extensions from exogenous obligations into self-endorsed vocational imperatives (Wang and Li, 2022). While their efficacy may be inferior to that of mandatory or incentive measures, they are more likely to garner the psychological recognition of the target group and engender a sustainable motivation for behavioral change.

Based on the above analysis, different policy instruments exhibit differentiated impact pathways in different contexts. Although previous studies have classified and discussed the effects of mandatory, incentive, and soft regulation measures, empirical analysis of delayed retirement among university teachers remains insufficient, especially in terms of the combined effects of policy instruments and the relationship between individual willingness formation mechanisms. Therefore, this study proposes the core hypotheses:

H1: Policy instruments can influence teachers' willingness to delay retirement.

2.3. Occupational environment and willingness to delay retirement

Teachers' occupational environment is a complex and multidimensional concept (Benevene et al., 2020). This study is based on 20 empirical studies that are grouped into four core dimensions: physical infrastructure, interpersonal relationships, school culture, and digital management, to collectively explore how the occupational environment plays a role in teachers' willingness to delay retirement.

First, Physical infrastructure refers to teaching and office conditions that are closely related to work efficiency and physical health. Comfortable environments demonstrably enhance employee job satisfaction, thereby reducing occupational burnout (Sander et al., 2019; Kearney et al., 2023), which provides a physiological basis for teachers to delay retirement. However, the proliferation of smart devices brought about by the digital transformation has created new adaptation pressures, and Sánchez-Prieto et al. (2019) found that some older teachers have low levels of acceptance of digital teaching tools, and technological anxiety may counteract the positive effects of an improved physical environment. This paradox cannot be ignored in studies of teachers' willingness to delay retirement.

Second, interpersonal relationships are the constructed emotional bonds between individuals in the workplace. Establishing a network of harmonious and mutually supportive interpersonal relationships is a key factor in stimulating work enthusiasm, as well as influencing employees' decisions about whether to delay retirement (Bardach et al., 2022). Of note, Solinge and Henkens (2014) found that aging increases teachers' sensitivity to emotional values and that recognition or support from leaders and colleagues can translate into significant mental motivation. This emotional connection not only shapes the daily collaborative atmosphere but also becomes an important support against psychological inertia in retirement in the later stages of the career.

In addition, School culture, as the linchpin of workplace ethos, may profoundly shape teachers' decisions to delay retirement. Schneider et al. (2013) demonstrated that organizational culture, via value dissemination, attitude formation, and systemic decision-making, dictates the texture of occupational environments. Stengård et al. (2023) further confirmed that in a similar corporate atmosphere, older workers' occupational stress is significantly alleviated, which may delay their tendency to leave. However, the internal mechanisms by which cultural atmosphere is transformed into behavioral intentions still require further empirical testing, especially among university faculty members.

Finally, digital management has been at the core of the digital transformation of educational administration in recent years. Stengård et al. (2023) emphasized that efficient management can significantly reduce employees' administrative burdens and workloads, thereby enhancing their willingness to continue working. Mat Rahimi et al. (2019) proposed that digital management, by streamlining processes and enhancing transparency and fairness, not only optimizes the teacher experience but also helps to stimulate their sense of professional self-worth. Although research in this area has increased, systematic quantitative

exploration of its impact on retirement intentions remains limited.

In summary, the influence of the teaching occupational environment on the willingness to delay retirement exhibits multi-pathway characteristics. These four factors do not act independently but form a dynamic interactive system. However, there is still a lack of empirical research on the specific interaction methods of this system. Therefore, this study proposes the hypothesis:

H2: Occupational environment influences teachers' willingness to delay retirement.

2.4. The mediation role of psychological mechanisms

Research in different domains indicates that policy can shape individual willingness and behavior by impacting fundamental psychological processes. For instance, regarding environmental problems, policies have been shown to alter people's risk perceptions and adaptive appraisals, which in turn affect their likelihood of engaging in protective actions (Xue et al., 2021). Likewise, the MINDSPACE behavioral science framework also draws attention to the role of subtle policy cues like framing and social norms in eliciting behavior change by shaping cognitive and emotional reactions (Dolan et al., 2012). These findings validate that psychological processes, such as beliefs, perceived norms, and emotions, are frequently essential mediators of policy impact (Carrus et al., 2021; Sunstein, 2016).

Aside from cognition at the individual level, policies can also influence social attitudes and group identity. According to policy feedback theory, recurring experience with public policies can affect citizens' political engagement, institutional trust, and sense of belonging to public institutions (Mettler and Soss, 2004). These findings suggest that policies are not only regulatory mechanisms but also psychological mechanisms that redefine individuals' understanding of their roles and competencies within institutional settings. Focusing on university teachers, this psychological path may be of specific importance. As delayed retirement policies are gradually introduced in higher education, teachers' willingness to remain in the workforce likely depends not only on policy content but also on how such policies shift their personal attitudes, perceived social expectations, and sense of control over continued employment.

Meanwhile, the occupational environment also plays a crucial role in retirement planning. For instance, it is known that when teachers enjoy positive peer relationships, academic freedom, and equitable treatment, there is greater job satisfaction and commitment (Browne et al., 2019; Stevens et al., 2022). On the other hand, age discrimination, bureaucratic control, and lack of support from administrators can undermine a teacher's sense of self-efficacy and diminish their institutional commitment.

In summary, policy instruments and occupational environments reshape individuals' multidimensional psychological states, including attitudes toward delayed retirement, perceived social expectations (subjective norms), and confidence in and perceived control over one's ability to continue working (perceived behavioral control). These psychological mediating processes ultimately translate into teachers' willingness to delay retirement, reflecting the core mechanism by which policies shift from external regulation to internal motivation. Thus, based on the literature review above, this study can put forward the following hypotheses:

H3: Psychological mechanisms influence teachers' willingness to delay retirement.
H4: Psychological mechanisms mediate the relationship between policy instruments and teachers' willingness to delay retirement.
H5: Psychological mechanisms mediate the relationship between occupational environment and teachers' willingness to delay retirement.

3. Method

3.1. Population and sample group

This study targeted university teachers in Sichuan Province, China, employing a stratified random sampling strategy; the top five cities by university count (encompassing 68.35% of Sichuan Province's universities) were selected. Questionnaires were proportionally distributed across these cities based on their university numbers. and administered through online platforms, email, and in-person visits. Based on structural equation modeling (SEM) requirements, a sample size between 200 and 500 is recommended for complex models to ensure estimation stability (Hair et al., 2010). This study initially aimed for 500 valid responses. While considering the efficiency of the sample, an additional 10% - 15% of the sample size, i.e., 575 (an additional 15%), was usually added. To reduce non-response bias, the questionnaire was designed to be concise, and multiple reminders and anonymous completion were used to increase the response rate. After collection, abnormal questionnaires were excluded, and 490 valid samples were ultimately retained (85.21% validity rate).

A few missing values were imputed using the means to ensure data integrity. Demographic characteristics included gender (261 male, 229 female), age (31 aged < 30, 207 aged 30–39, 163 aged 40–49, 49 aged 50–59), education (90 bachelor's, 271 master's, 129 doctoral), academic rank (86 junior, 205 intermediate, 148 associate senior, 51 senior), and teaching experience (80 < 5 years, 170 5–10 years, 169 11–20 years, 71 > 20 years).

3.2. Research instruments

The questionnaire was developed by adapting validated scales, followed by three rounds of expert consultations (2 public policy specialists and 1 educational administration expert) to refine item wording, and a pilot test (n = 30) assessed reliability. The final instrument comprised four parts: (1) policy instruments (14 items, 3 dimensions); (2) occupational environment (19 items, 4 dimensions); (3) psychological mechanisms (15 items, 3 dimensions); and (4) willingness to delay retirement (19 items). While the first three parts adopted established dimensional frameworks, the fourth parts—lacking clear theoretical antecedents—underwent exploratory factor analysis (EFA) to extract three dimensions: cognitive willingness, affective willingness, and behavioral willingness (all values comply with factor loadings > 0.4 and cumulative variance > 60%). Then, the four parts passed Harman's single-factor test (the value of the first unrotated factor is 30.08% below 40%). All items used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

In addition to the structured questionnaire, brief semi-structured interviews were conducted with 9 university teachers from different universities in Sichuan Province, focusing primarily on their attitudes and views towards delayed retirement. The aim was to complement the quantitative analysis's explanatory power, particularly by providing deeper insight into the psychological mechanisms involved among teachers and hence adding contextual meaning and theoretical depth to the findings of the study.

3.3. Data analysis

Data analysis proceeded in three phases using SPSS 26.0 and AMOS 28.0. First, measurement models were validated through confirmatory factor analysis (CFA) with the following fit thresholds: $\chi^2/df < 3$, CFI > 0.90, TLI > 0.90, RMSEA < 0.05, and SRMR < 0.08. Convergent validity was assessed via AVE > 0.50 and CR > 0.70, while discriminant validity required AVE square roots exceeding inter-construct correlations. Internal consistency was confirmed by Cronbach's alpha values > 0.70 across all scales. Second, SEM tested hypothesized relationships among variables, standardized path coefficients (β) with p-values < 0.05 were considered statistically significant. Finally, Mediation effects were examined using 5,000 bootstrap samples with bias-corrected 95% confidence intervals. Model fit adhered to the same criteria as CFA.

4. Results

4.1. Measurement model testing

Reliability analysis is an important prerequisite to ensure the quality of data. In this study, the internal consistency of each dimension was examined by Cronbach's Alpha coefficient, which ranges from 0 to 1, with higher values indicating better reliability. Referring to academic standards, when coefficient ≥0.9 denotes excellent reliability, 0.8-0.9 strong reliability, 0.7-0.8 acceptable reliability, 0.6-0.7 marginal reliability, and < 0.6 necessitates scale revision or data recollection.

As shown in Table 1, the Cronbach's alpha coefficients of the four core variables exceeding 0.9, including policy instruments (α = 0.929), occupational environment (α=0.937), psychological mechanism (α = 0.921), and willingness to delay retirement (α = 0.946), Each sub-dimension also demonstrated coefficients > 0.8, indicating that the scales of this study have excellent internal consistency, laying a reliable foundation for subsequent validity analysis.

To verify construct validity, measurement models for all variables were constructed using AMOS 28.0, with standardized factor loadings calculated via maximum likelihood estimation. All item loadings fell within 0.691–0.828 (p < 0.001), surpassing the 0.5 threshold, confirming adequate reflection of latent constructs.

Then, the average variance extracted (AVE) and combined reliability (CR) were further calculated. The results are shown in Table 1. All constructions had AVE values ranging from 0.561 to 0.669 and CR values ranging from 0.861 to 0.923, which were all greater than the standardized values, indicating that the construct dimensions had good convergent validity and internal consistency.

In addition, the Fornell-Larcker criterion was used to test the discriminant validity among variables. In this criterion, the square roots of AVE values for each construct exceeded their inter-construct correlations (Table 1), indicating that the items effectively measure the constructions of their respective dimensions. Finally, the values of fit indices of the measurement model, as shown in Table 2, are all greater than the standardized values, indicating that the models fit the data well.

4.2. Structural model testing

The structural equation model was established, as shown in Fig. 1. The model fitting results showed that $\chi^2/df = 1.35$ (< 3), RMSEA = 0.027 (< 0.05), CFI = 0.963 (> 0.9), TLI = 0.961 (> 0.9), GFI = 0.840 (> 0.8 acceptable) and SRMR = 0.040 (< 0.08), which indicated that the model fit was excellent.

In addition, Path analysis results revealed significant direct effects: policy instruments positively influenced willingness to delay retirement (β = 0.365, p < 0.001), supporting hypothesis 1; occupational environments demonstrated some positively influenced willingness to delay retirement (β = 0.142, p < 0.05), supporting hypothesis 2; psychological mechanisms also showed significant direct effects (β = 0.361, p < 0.001), supporting hypothesis 3.

Table 1: Reliability and validity analyses

Variables	Dimensions	Indicators	Loading factors	Cronbach's alpha (>0.7)	AVE (>0.5)	CR (>0.7)
Policy instruments				0.929		
	Mandatory measures (MM)	MM1	0.787	0.896	0.639	0.895
		MM2	0.807			
		MM3	0.784			
		MM4	0.812			
		MM5	0.806			
	Incentive measures (IM)	IM1	0.827	0.883	0.669	0.890
		IM2	0.828			
		IM3	0.828			
		IM4	0.790			
	Soft regulation measures (SRM)	SRM1	0.756	0.877	0.590	0.878
		SRM2	0.777			
		SRM3	0.762			
		SRM4	0.775			
		SRM5	0.771			
Occupational environment				0.937		
	Physical infrastructure (PI)	PI1	0.721	0.818	0.561	0.864
		PI2	0.723			
		PI3	0.747			
		PI4	0.742			
	Interpersonal relationship (IR)	IR1	0.807	0.905	0.657	0.884
		IR2	0.801			
		IR3	0.815			
		IR4	0.823			
		IR5	0.808			
	School culture (SC)	SC1	0.756	0.874	0.586	0.876
		SC2	0.755			
		SC3	0.768			
		SC4	0.774			
		SC5	0.776			
	Digital management (DM)	DM1	0.756	0.856	0.561	0.864
		DM2	0.765			
		DM3	0.706			
		DM4	0.751			
		DM5	0.766			
Psychological mechanism				0.921		
	Attitude (AT)	AT1	0.771	0.878	0.591	0.878
		AT2	0.779			
		AT3	0.778			
		AT4	0.755			
		AT5	0.764			
	Subjective norm (SN)	SN1	0.755	0.858	0.554	0.861
		SN2	0.799			
		SN3	0.705			
		SN4	0.762			
		SN5	0.699			
	Perceived behavioral control (PBC)	PBC1	0.755	0.875	0.590	0.878
		PBC2	0.779			
		PBC3	0.758			
		PBC4	0.773			
		PBC5	0.777			
Willingness to delay retirement				0.946		
	Cognitive willingness (CW)	CW1	0.767	0.921	0.602	0.923
		CW2	0.775			
		CW3	0.768			
		CW4	0.759			
		CW5	0.765			
		CW6	0.793			
		CW7	0.796			
		CW8	0.784			
	Affective willingness (AW)	AW1	0.763	0.898	0.601	0.900
		AW2	0.755			
		AW3	0.794			
		AW4	0.794			
		AW5	0.762			
		AW6	0.781			
	Behavioral willingness (BW)	BW1	0.691	0.862	0.561	0.864
		BW2	0.762			
		BW3	0.767			
		BW4	0.758			
		BW5	0.766			

Table 2: Model fit indices

Models		χ^2/df (<3)	CFI (>0.9)	GFI (>0.9)	TLI (>0.9)	SRMR (<0.05)	RMSEA (<0.05)
Measurement models	Policy instruments	1.556	0.990	0.968	0.988	0.025	0.033
	Occupational environment	1.480	0.986	0.954	0.989	0.028	0.031
	Psychological mechanism	1.415	0.991	0.969	0.991	0.024	0.029
	Willingness to delay retirement	1.522	0.986	0.949	0.984	0.024	0.033
Structural model		1.350	0.963	0.840	0.961	0.040	0.027

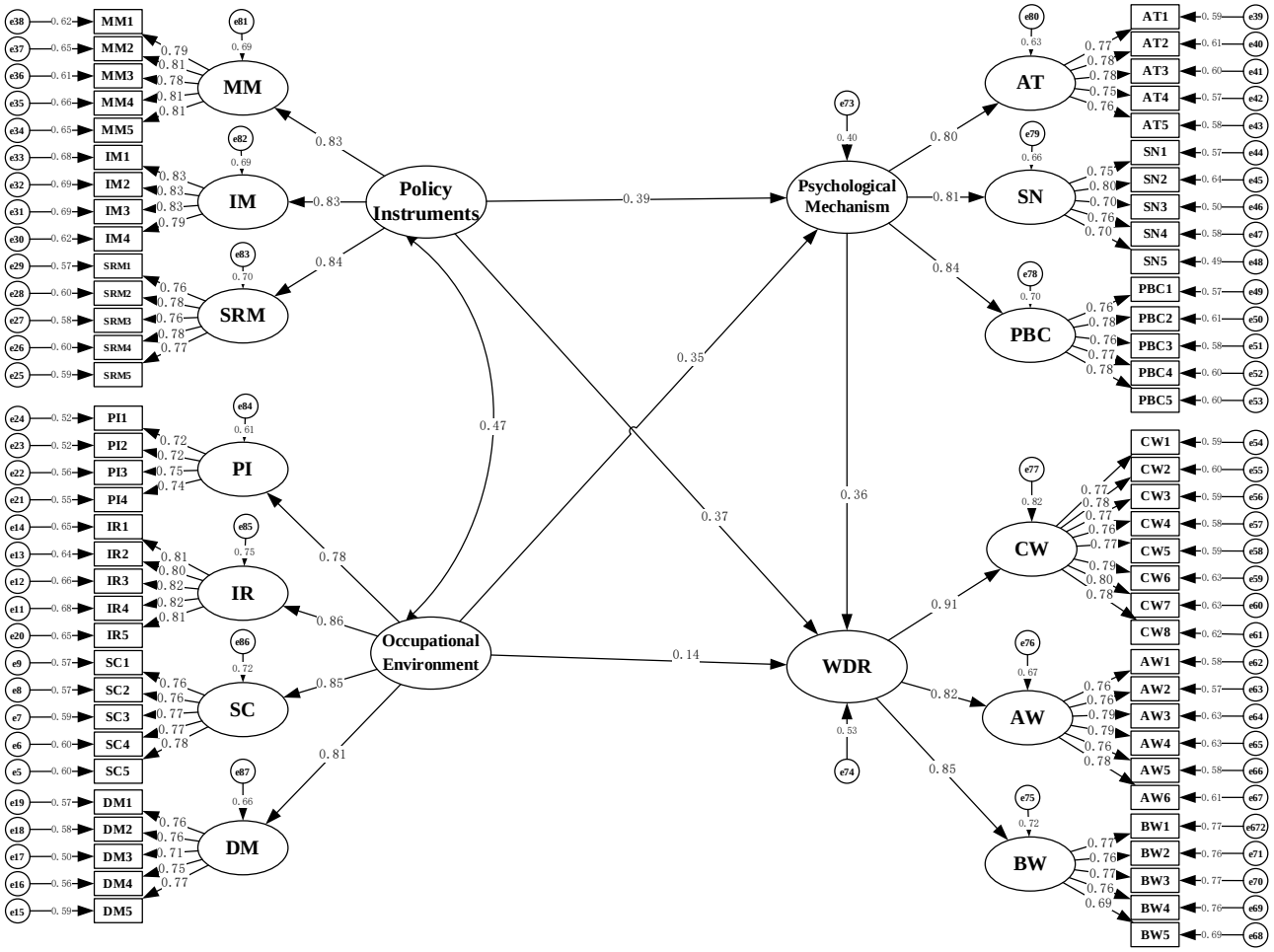

Fig. 1: Structural equation modeling fitting results

4.3. Mediation analysis

The Bootstrap method tested the mediating effect of psychological mechanisms, as shown in Table 3. The results show that policy instruments indirectly affected willingness to delay retirement through psychological mechanisms (β = 0.140, p < 0.001), accounting for 27.72% of the total effect (0.505), supporting hypothesis 4; Occupational environments similarly exerted indirect effects via psychological mechanisms (β = 0.125, p < 0.001), explaining 46.82% of the total effect (0.267), thus hypothesis 5 is established.

Table 3: Path test results

Path	Effect	Estimate	Standard estimate	P	95%CI	
					Lower	Upper
Policy instruments→psychological mechanism	Indirect	0.285	0.389	0.001	0.284	0.491
Policy instruments→willingness to delay retirement	Direct	0.266	0.365	0.001	0.243	0.478
Occupational environment→psychological mechanism	Indirect	0.324	0.347	0.000	0.238	0.453
Occupational environment→willingness to delay retirement	Direct	0.131	0.142	0.014	0.029	0.248
Psychological mechanism→willingness to delay retirement	Indirect	0.358	0.361	0.000	0.244	0.481

5. Discussion

The research demonstrates that policy instruments have a positive effect on willingness to delay retirement (β = 0.365, p < 0.001), validating Hypothesis 1. This effect arises from a multidimensional synergistic mechanism.

First, as Kundu et al. (2025) noted, organizational behavior is often influenced by the rigid constraints of the external institutional environment. For teachers in public universities, their institutional affiliations inherently subject their behavioral choices to systemic norms. This institutional influence is not simply external pressure, but

through the internal norms of the organization, gradually internalized into the collective cognition of the teachers' group, and fostering a "voluntary compliance" inertia toward delayed retirement (Li et al., 2020). Second, incentive measures follow the performance logic of New Public Management (NPM), emphasizing precise alignment between individual behavioral intentions and policy objectives through resource redistribution (Javaudin et al., 2024). The effectiveness of such measures stems from the immediacy and visibility of the benefits. When teachers perceive that the benefits of delayed retirement are higher than those of early retirement, their willingness to delay retirement will be greatly enhanced. Finally, soft regulation measures exert non-compulsory influence through lateral guidance, ability empowerment, or cultural identity construction, thus indirectly influencing teachers' willingness to delay retirement (Başar, 2024).

In summer, the above three components form a "mandatory constraints-incentives-soft regulation" policy architecture that resonates with Vedung's (1998) classic framework in Carrots, Sticks, and Sermons. This composite strategy demonstrates far greater efficacy in shaping willingness and behavior compared to single-dimension policies.

Next, the work environment positively influences teachers' propensity to postpone retirement ($\beta = 0.142$, $p < 0.05$), thereby lending support to Hypothesis 2. This influence, nevertheless, appears more modest, with lag response and diminishing marginal rate of return.

Firstly, the adoption of intelligent teaching aids can entail additional learning effort. For older teachers near retirement, limited flexibility for new technologies can lead to psychological resistance (Salthouse, 2019), basically nullifying the benefit of an improved environment. Such a paradox reflects Habermas' (1985) criticism of technological rationality—progress without human and social regard can hasten novel tensions. Second, although healthy social relationships can enhance motivation and extend professional commitment, they also demand continued emotional investment, and their impact can diminish over time as a consequence of habitual conflict or diminishing novelty (Bardach et al., 2022; Wang and Klassen, 2023). Third, school culture influences behavior through long-term organizational identification, which is a process that takes time to develop and hence has a lagged effect (Wang and Huang, 2025). Finally, electronic administration tools such as automated systems and algorithm-based evaluations can increase productivity but also generate performance anxiety, specifically among older teachers, due to over-estimation.

In short, while the workplace directly affects retirement decisions, its general effect is relatively limited and mostly restricted to psychological mechanisms.

Notably, Psychological mechanism plays a mediating role in both policy instruments and occupational environment pathways, confirming Hypotheses H3, H4, and H5, but there are significant differences in the magnitudes and mechanisms. The mediating effect in the policy instruments pathway (27.72%) is significantly lower than that in the occupational environment pathway (46.82%).

The findings suggest that the occupational environment influences teachers mainly by shaping their psychological mechanisms, whereas policy instruments operate at a more surface level, involving less deep psychological processing. One teacher explained that if the university continued to improve working conditions, such as providing better office spaces or reducing administrative work, they would be more likely to stay longer, since these changes would make the job feel “less of a chore and more encouraging.” This illustrates how workplace improvements can foster positive emotions and intrinsic motivation, thereby increasing the likelihood of delaying retirement.

This reliance on the occupational environment is particularly strong in universities in western China, such as those in Sichuan Province. Existing studies indicate that, compared with the better-resourced universities in eastern regions, universities in the west often have weaker management, limited support systems, and poorer infrastructure. Consequently, teachers in these areas place stronger expectations on improvements in their work environment and respond more sensitively at a psychological level (Liu and Ma, 2018; Zhan et al., 2023). In such contexts, the occupational environment shapes teachers’ behavior primarily by fulfilling their basic needs for emotional support and belonging.

By contrast, policy instruments exert their influence more directly, shaping teachers’ perceptions of retirement policies through institutional rules and regulations, which reduces the need for deeper cognitive processing. As one teacher observed, “Now that the government has introduced the postponed retirement policy, there is definitely expected compliance. However, the operative factor depends on how it is implemented by the university. If the policy would consider our practical limitations, I would be happy to accept it and feel less resistant.” This suggests that responses to policy instruments are largely compliance-driven and externally motivated, rather than emerging from deeper personal reflection. These differences help explain the variation in mediating effects between the two factors.

Overall, the estimated effect sizes of policy instruments and the occupational environment on teachers’ willingness to delay retirement are 0.505 and 0.267, respectively. This significant difference highlights the tensions faced during China’s transition from the traditional civil service system to a market-oriented employment system in higher education. As teachers’ professional identities shift from lifetime contracts to fixed-term appointments, their decision-making increasingly reflects the logic of a “rational economic agent.” In this context, policy

instruments align more closely with market-oriented goals of maximizing benefits, making them more effective than the more implicit influence of organizational culture and emotional bonds in the occupational environment.

Furthermore, while fixed-term appointment reforms are widely implemented in eastern China, universities in Sichuan Province continue to rely heavily on the traditional civil service system, which is deeply embedded in institutional culture. As a result, teachers in this region depend more strongly on policy signals, while their responses to gradual improvements in workplace conditions are relatively slow. This dynamic further amplifies the impact of policy instruments compared with the occupational environment.

6. Conclusion and recommendations

By integrating the TPB and SCT, this study systematically reveals the mechanisms and boundary conditions of policy instruments and occupational environment on university teachers' willingness to delay retirement. The main conclusions are as follows: first, policy instruments show a significant positive dominant effect, which is the core driver of willingness to delay retirement, and its effect is realized through the three-dimensional synergy of "mandatory constraints-incentives-soft regulation," which confirms the necessity of composite policy design. Second, the occupational environment also positively affects teachers' willingness to delay retirement, but its effect is latent, delayed, and diminishing marginal utility. Finally, the psychological mechanism has a certain mediating role, but the influence effect in the occupational environment path is much higher than that in the policy instruments path, which mainly stems from the direct perceptual impact of explicit policy instruments and the cognitive conversion of the occupational environment.

Based on research conclusions, this study proposes the following practical recommendations: First, the design of university policy implementation should emphasize multi-dimensional coordination, combining the mandatory retirement age with incentive mechanisms, such as designing different tiers of pension ratios, while improving policy interpretation and feedback channels. Second, optimize the occupational environment through digital transformation, focusing on enhancing teaching efficiency and reducing administrative burdens, such as deploying intelligent teaching assistance tools and conducting age-friendly digital training to alleviate technical adaptation pressures. Third, provide psychological support, such as retirement and new technology adaptation training, to enhance teachers' confidence and sense of control regarding delayed retirement. By synergistically optimizing policies and the environment, this approach helps stimulate teachers' intrinsic motivation to delay retirement.

However, this study has the following limitations: Firstly, the sample for this study primarily comes from universities in Sichuan Province, China, where the regional environment and cultural context have certain unique characteristics. The generalizability of the study's conclusions still needs to be validated in other regions to confirm the finding. In addition, while the research methodology primarily relies on quantitative methods, supplemented by brief interviews to enhance explanatory power, the qualitative component has limited coverage and cannot fully capture the complex psychological processes of teachers. Finally, the variables are focused on foundational dimensions and have not yet fully incorporated emerging factors that may arise from digital transformation. Future research will expand the regional sample, deepen and broaden the scope of interviews, and develop more contextually adaptive mixed research methods. Additionally, variables with greater cutting-edge and contemporary characteristics will be introduced to enhance the explanatory power and theoretical innovation of the model.

List of abbreviations

AMOS	Analysis of moment structures
AT	Attitude
AVE	Average variance extracted
AW	Affective willingness
BW	Behavioral willingness
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CR	Combined reliability
CW	Cognitive willingness
DM	Digital management
EFA	Exploratory factor analysis
GFI	Goodness-of-fit index
IM	Incentive measures
IR	Interpersonal relationship
MM	Mandatory measures
PBC	Perceived behavioral control
PI	Physical infrastructure
RMSEA	Root mean square error of approximation
SC	School culture
SCT	Social cognitive theory
SEM	Structural equation modeling
SN	Subjective norm
SPSS	Statistical package for the social sciences
SRM	Soft regulation measures
SRMR	Standardized root mean square residual
TLI	Tucker-Lewis index
TPB	Theory of planned behavior

Compliance with ethical standards

Ethical considerations

This study was conducted in accordance with the ethical principles of research involving human participants. Prior to participation, all respondents were informed about the purpose of the study, assured of the anonymity and confidentiality of their responses, and gave their voluntary informed consent.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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