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Innovation: Early Leadership and Age Dynamics -Evidence from Chinese SMEs

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Abstract

This study investigates the relationship between early leadership experiences on innovation performance in small andmedium-sized enterprises (SMEs) in China. Using Enterprise Survey for Innovation and Entrepreneurship in China (ESIEC) cross-sectional datasets, it examines the mediating role of psychological traits and how age moderates this relationship. The analysis employs fixed effects models to control for regional and industry-specific unobserved characteristics. Results indicate a significant positive relationship between early leadership experiences and innovation,with psychological traits mediating this relationship strongly in younger entrepreneurs. For older entrepreneurs, early leadership has a more direct and stronger shape on innovation. These findings underscore the importance of early leadership development in education phase and suggest that the relationship and pathways evolve with age, offering novel insights into the formation and application of social and human capital in the entrepreneurial journey.

Keywords: Entrepreneurial Innovation, Leadership Experience, Psychological Traits, SMEs, Human Capital, Social Capital

Introduction

Innovation is the cornerstone of entrepreneurial success and a key driver of economic growth in modern bl usiness and scapes. The ability of entrepreneurs to innovate not only relates to their ventures' trajectories but also contributes to broader industry trends and a country's economic development.

Therefore, understanding the factors that foster entrepreneurial innovation is crucial for cultivating effective business strategies and nurturing an environment conducive to entrepreneurial success. This study explores early leadership experiences and the psychological traits of entrepreneurs, examining how these traits relate to innovation performance in businesses. These traits are further examined for their mediating role in the relationship between early leadership experiences and innovation performance in businesses.

While some research has examined the various determinants of entrepreneurial innovation, the specific relationship between leadership roles during educational phases and psychological traits across different age groups has not been thoroughly investigated. This study integrates life course theory to explore how these early experiences relate to innovation at different stages of an entrepreneur's life, highlighting that the timing of these experiences can relate to their outcomes, thereby addressing this gap. It seeks to examine the mediating role of psychological traits, such as risk propensity, self-confidence, and philanthropic tendencies, as well as the moderating effect of age on this relationship.
This study is guided by the following research questions: How are early leadership experiences during the educational phase associated with an entrepreneur's current enterprise innovation performance? What roles do psychological traits play in this dynamic, and how are these relationships influenced by the entrepreneur's age?

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In small- and medium-sized enterprises (SMEs), an entrepreneur's personal traits and experiences can have a more immediate and observable shape on the company's direction, culture, and innovation. The smaller scale and less formalized structure of these businesses means that individual leadership qualities can directly relate to organizational outcomes. Larger enterprises, with their more complex and established systems, often exhibit dilution of individual impact. In such settings, the role of a single leader's experiences and traits might be less discernible and absorbed by broader institutional processes and systems.

This pronounced impacts on SMEs makes them an ideal context for studying the effects of early leadership experiences on entrepreneurial innovation. Understanding how these personal experiences relate to SMEs' innovation strategies and outcomes can provide valuable insights into the broader narrative of entrepreneurial success and firm growth.

This study is expected to make significant contributions to the field of entrepreneurial studies, particularly in understanding the nuanced roles of early life experiences and intrinsic traits in shaping innovation. The findings are expected to provide valuable insights for entrepreneurs, educators, and policymakers, aiding the development of targeted strategies to foster innovation in entrepreneurial ventures.

Following this introduction, this study presents a detailed literature review that sets the context for this study. Subsequentsections describe the methodology, present the findings, discuss the implications of the results, and conclude with a summary of key insights and potential avenues for future research.

Background Literature and Hypotheses

A. Early Leadership Experiences and Entrepreneurial Innovation

Research has increasingly focused on the role of early leadership experience on subsequent entrepreneurial activities. For instance, studies such as Dempster and Lizzio (2007) have speculated on the importance of student leadership roles and their influence on future career trajectories (Dempster & Lizzio, 2007). Lundin et al. (2021) also found that leadership experiences before labor market entry significantly boosted early career outcomes (Lundin et al., 2021). The relationship between early leadership experience and entrepreneurial innovation is complex. For instance, a study on millennial district heads in Indonesia by Sardini et al. (2022) observed that early leadership experience influences human development indices, suggesting a correlation between these experiences and leadership effectiveness in organizational settings. This notion aligns with our research finding that early leadership roles such as being a class leader can significantly enhance entrepreneurial innovation performance, especially as entrepreneurs age.

Several studies have explored the mediating and moderating roles of various factors in the relationships between personal traits, early experiences, and entrepreneurial outcomes. For instance, the mediating role of previous entrepreneurial education in shaping intentions and the moderating effect of previous employment experience, as discussed by Le et al. (2023) and Leitch et al. (2013), are significant (Le et al., 2023; Leitch et al., 2013). Building on these findings, our study examines whether early leadership roles contribute to enhanced innovation performance in entrepreneurial ventures. This is especially relevant given the evolving nature of leadership skills and their applicability in business innovation. The research aligns with the broader discourse on how formative experiences shape leadership qualities essential for entrepreneurial success.

B. Early Leadership and Human Capital Development

Early leadership roles play a part in developing the skills and traits that form the core of human capital in entrepreneurship, especially as entrepreneurs age. Studies such as that of Latifah et al. (2022) emphasize the importance of human capital in innovation, particularly in the context of young entrepreneurs' SMEs. They highlight the role of social media networking and knowledge sharing as crucial mediators, suggesting that skills developed through early leadership experiences are later enhanced and utilized for innovation success (Latifah et al., 2022). Knox et al. (2020) researched into the development of authentic leadership through educational experiences, particularly in social entrepreneurial innovation. This highlights how early leadership roles contribute to behavioral development and the creation of effective learning environments, fostering essential leadership skills in social enterprise contexts (Knox et al., 2020). These studies align with our findings, suggesting a dynamic change in reliance on different capitals for innovation across age groups. While younger entrepreneurs may leverage psychological traits and previous government roles, older entrepreneurs appear to rely more on their developed human and social capital, such as enhanced networking skills and the comprehensive abilities gained from early leadership roles, to drive innovation in their ventures. This shift in mechanisms reflects the changing nature of entrepreneurial resources and strategies across the lifespan.

C. Psychological Traits and Entrepreneurship

Saiz-Alvarez (2022) indicates that research on entrepreneurial intention during the COVID-19 pandemic is increasingly linked to entrepreneurship education and psychological traits, highlighting the importance of educational phases in shaping entrepreneurial spirit (Saiz-Alvarez, 2022). The role of entrepreneurial psychological traits as mediators in the relationship between early leadership experience and innovation performance is well documented. Gupta et al. (2004) developed a construct of entrepreneurial leadership, highlighting the impact of personality traits on leadership effectiveness (Gupta et al., 2004). Similarly, Kerr et al. (2018) reviewed entrepreneurs' personality traits, emphasizingtheir shape on entrepreneurial behavior (Kerr et al., 2018).

The concept of positive psychological capital, which includes factors such as self-efficacy, optimism, hope, and resilience, is increasingly recognized as crucial in the entrepreneurial context. The impact of psychological traits on entrepreneurial innovation is a well-established topic in literature. Sidek and Zainol (2011) found that traits such as the need for achievement, risk-taking propensity, and internal locus of control significantly shaped business performance among entrepreneurs in Malaysia's civil construction industry (Sidek & Zainol, 2011). Similarly, Chaudhary (2017) identified that traits such as locus of control, tolerance for ambiguity, self-confidence, and innovation differentiate entrepreneurs from non-entrepreneurs, although the need for achievement and risk-taking propensity did not show significant differences between the two groups (Chaudhary, 2017). Envick's research underscores the importance of these psychological resources for both short- and long-term entrepreneurial success (Envick, 2005) This aligns with our research,which suggests that psychological traits developed through early leadership experiences can significantly shape entrepreneurial innovation. Our study extends these findings by demonstrating the mediating roles of risk propensity, self-confidence, and philanthropy in younger entrepreneurs.

D. Previous Government Employment and Age Disparities

Previous government employment as a mediator has received little attention in literature. However, our research introduces this variable and finds its significance in the entrepreneurial journey of younger entrepreneurs. This aspect can be related to studies such as Leitch et al. (2013), who emphasized the development of entrepreneurial leadership through social and institutional capital, possibly acquired from previous government roles (Leitch et al., 2013). However, existing research has identified potential negative influences of factors such as gender, previous government employment, and redundancy on small business formation. This suggests that the transition from government roles to entrepreneurship may present unique challenges that relate to the entrepreneurial process (Cenđić, 2019).

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In Age and High-Growth Entrepreneurship (Azoulay et al., 2020), the authors challenge the common perception that young individuals are predominantly responsible for high-growth entrepreneurship. This study resonates with our findings that older entrepreneurs may exhibit stronger influences from early leadership experience on innovation performance due to accumulated skills and networks (Azoulay et al., 2020). Max Planck (1949), although not directly related to entrepreneurship, offers a historical perspective on the evolution of scientific thought and its dependence on generational shifts, indirectly supporting the notion that innovation is influenced by age and the generational context.

The impact of age on entrepreneurial behavior and outcomes has been a subject of interest in several studies. Kerr et al. (2018) reviewed the personality traits of entrepreneurs, acknowledging that their expression and shape on entrepreneurial activities may vary with age (Kerr et al., 2018). The age-related dynamics observed in our study are particularly intriguing. To further understand how age influences the role of early leadership experiences on innovation, we integrate Life Course Theory (Elder, 1994). This theory suggests that the timing of life experiences, such as early leadership roles, can have different implications depending on an individual's stage in life. Younger entrepreneurs might benefit more from psychological traits like risk-taking due to their stage in the entrepreneurial lifecycle, involving more experimentation and learning. In contrast, older entrepreneurs may leverage their accumulated social and human capital more effectively, reflecting cumulative advantage theory (DiPrete & Eirich, 2006), which implies that early successes can accumulate over time, leading to a stronger relationship on innovation in later stages of an entrepreneur's career. This finding echoes the work of Renko et al. (2015), who explored how entrepreneurial leadership style varies in different contexts (Renko et al., 2015). The age disparity in mediating effects suggests a dynamic entrepreneurial landscape in which experience and age alter reliance on certain entrepreneurial traits and strategies. Thus, our research addresses a significant gap in the literature by exploring how psychological traits and government experience relate to entrepreneurial innovation across different age groups.

Based on the related work, we propose the following hypotheses in our study:

H1: Early leadership experience as a student class leader positively relates to entrepreneurial innovation performance.

H2: This phenomenon is stronger for older entrepreneurs compared to younger ones, indicating an age-related dynamic in the roles of early leadership experience.

H3: For younger entrepreneurs, psychological traits (risk propensity, self-confidence, philanthropy) play a significant mediating role in innovation performance.

H4: In contrast, for older entrepreneurs, these mediating effects diminish or change, reflecting different mechanisms driving innovation at different age stages.

Data, Measurement and Empirical Design

A. Data

This study utilized data from the 2018 Enterprise Survey for Innovation and Entrepreneurship in China (ESIEC), which was conducted by the Enterprise Big Data Research Center at Peking University. The center is dedicated to the collection and integration of enterprise big data, merging it with data from ESIEC surveys to conduct academic and policy research. This effort supports national policy formulation and market entity decision making by providing data and intellectual support.

The ESIEC survey underwent three preliminary surveys between 2016 and 2017. These included:

1) April 2016: A survey in Jiangmen, Guangdong Province, focusing on small and micro-enterprise innovation and entrepreneurship, with 2,800 enterprise samples.

2) July-August 2016: A survey in Xiayi County, Henan Province, contacting 350 enterprise samples.

3) July-August 2017: A survey across 16 counties (cities, districts) in Henan Province, contacting 6,400 enterprise samples.

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The first baseline survey of the ESIEC was conducted between July and August 2018. This survey targeted privately owned and foreign-invested enterprises registered in China between 2010 and 2017 as well as their founders. The survey covered a wide range of topics related to entrepreneurs' history of starting businesses, the process of enterprise creation, operational status, innovation, network relationships, and the business environment. It was conducted across 117 counties in six provinces, Liaoning, Shanghai, Zhejiang, Henan, Guangdong, and Gansu, with 58,500 enterprise samples.

For our research, we exclusively used data from the 2018 Survey. Rigorous criteria were applied to ensure data quality, including the exclusion of instances with missing values. This dataset provides a rich source of information, allowing for a detailed examination of the relationship between early leadership experience, psychological traits, entrepreneurial innovation, and the moderating effect of age.

B. Model

To investigate the role of early leadership in entrepreneurial innovation performance, the study employs a multivariate regression model. This model is designed to parse the intricate relationships between a host of independent variables and the innovation performance of entrepreneurs' businesses. The primary regression model is expressed as follows:

$$Innov\_Perf_i=\beta_0+\beta_1\times Stud\_Lead_i+\ldots+\beta_{11}\times Comp\_Size_i+\epsilon_i$$

Where:

Innov_Perf_i is the dependent variable representing the innovative performance of a company. The independent variables include Trust, Future Confidence (Future_Conf), Risk, Student Leadership Experience (Stud_Lead), Charitable Activities (charity), Previous Political Participation (NPC_CPPCC), Government Experience (Gov_Exp), Pre-Entrepreneurial Non-Agricultural Experience (Pre_NonAgri), Local Work Experience (Loc_Work), GDP, and Company Size (Comp_Size). β0–β11 are the coefficients to be estimated. ϵi is the error term. Table 1 shows the specific description of each variable.

To be specific:

Dependent Variable:

Innov_Perf: Chosen as the primary measure of a company's innovation capability, which is the core focus of the study.

Independent Variables:

1) Trust, Future_Conf, and Risk Aversion (Psychological Traits): Included in capturing the role of an entrepreneur's psychological makeup on innovation performance. These traits are crucial for entrepreneurial decision making and risk assessment.

2) Stud_Lead (Early Leadership Experience): It is essential to evaluate the long-term role of early leadership roles on later entrepreneurial success.

3) Charity (Philanthropic Activities): Represents social responsibility and public image, which can relate to a company's innovative capacity and stakeholder trust.

4) NPC_CPPCC (Political Participation) and Gov_Exp (Government Experience): These variables provide insight into the relationship of political and governmental backgrounds on business innovation.

Control Variables:

1) Pre_NonAgri (Non-Agricultural Experience) and Loc_Work (Local Work Experience): These factors contribute to an entrepreneur's overall experience and skills, affecting their ability to innovate.

2) GDP: Included as control variables to account for the economic environment. This ensures that our model's findings are not confounded by broader regional economic factors.

3) Comp_Size (Company Size): Included as control variables to account for organizational scale, which is known to shape innovation. This ensures that our model's findings are not confounded by broader organizational factors.

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C. Measurement

Table 1. Variable Code Book

Variable	Description
stud_lead	Student Leadership Experience - Sum of leadership roles held during educational phases.
trust	Trust Level (0/1 Variable) - Indicates the level of trust in others based on the response to the question: 'Do you feel that most people can be trusted, or is it better to be careful in dealing with people?' 0 for less trust, 1 for more trust.
future_conf	Future Confidence (0-5 Score) - Level of confidence in one's own future, measured on a scale from 0 to 5.
npc_cppcc	NPC or CPPCC Participation (0-4 Score) - Indicates the level of political participation in NPC or CPPCC; 0 for no participation, and 1-4 indicating the level of participation (township to national level).
gov_exp	Government Work Experience (0/1 Variable) - Binary variable indicating previous work experience in government; 0 for no, 1 for yes.
pre_nonagri	Pre-Entrepreneurship Non-Agricultural Work (Count) - Number of non-agricultural work experiences before starting the business.
loc_work	Local Work Experience (0/1 Variable) - Binary variable indicating if there is any local work experience; 0 for no, 1 for yes.
gdp	Provincial GDP - Gross Domestic Product of the province.
comp_size	Company Size - Size of the company, measured by the number of employees.
risk_tol	Risk Tolerance (0-10 Score) - Entrepreneur's risk tolerance level, measured on a scale from 0 to 10.
self_conf	Self-Confidence (0-5 Score) - Entrepreneur's level of self-confidence, measured on a scale from 0 to 5.
charity	Charitable Giving - Total amount of donations made by the individual or their business, measured in ten thousand of yuan.
innov_perf	Innovation Performance calculated through factor analysis (principal component analysis)

Table2. KMO and Bartlett's Test

KMO Sampling Adequacy Measure		0.709
Bartlett's Test of Sphericity	Approximate Chi-Square	9111.224
Degrees of Freedom		15
Significance		0.000

Tbale3. Total Variance Explained

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	3.16233	1.69807	0.5271	0.5271
Factor2	1.46426	0.87775	0.244	0.7711
Factor3	0.58651	0.1537	0.0978	0.8689
Factor4	0.43281	0.14937	0.0721	0.941
Factor5	0.28344	0.2128	0.0472	0.9882
Factor6	0.07064	.	0.0118	1

Table4. Component Score Coefficient Matrix

Variable	Factor1	Factor2
NewSaleRate	0.35474	0.10447
Newproduct	0.37985	0.05912
NewproductSale	0.39462	0.0785
Introduce	0.02309	0.34108
Reduc_cost	0.08556	0.46535
Percen_Reduct	0.12061	0.44436

To measure innovation performance, this study employs principal component analysis (PCA), a factor analysis method, to construct a composite index from multiple indicators reflecting various aspects of innovation within a firm. The indicators used in this analysis include: NewSaleRate: The percentage of total sales accounted for by new products or services in the year 2017; Newproduct: A binary indicator of whether the firm introduced new products or services in 2017; NewproductSale: A binary indicator of whether new products or services were marketed in 2017; Introduce: A binary indicator of whether the firm had process innovations in 2017; Reduc_cost: A binary indicator of whether the process innovations introduced in 2017 led to a reduction in average costs; Percen_Reduct: The percentage reduction in unit costs due to process innovations in 2017.

Factor analysis begins with a set of variables, which are then standardized. Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were performed to assess the suitability of the data for factor analysis. Table 2 shows that the determinant of the correlation matrix and the significance level of Bartlett's test confirmed the intercorrelations among the variables, while a KMO value greater than 0.6 indicates adequate sampling.

Subsequently, the principal component factors were extracted, retaining those with eigenvalues greater than 1. In this case, two factors were retained, with the cumulative variance contribution rate reaching 77.25%, indicating that these factors explain a substantial portion of the variance in the variables. The factor loadings after varimax rotation provided a clearer interpretation of the relationship between the variables and factors.

Table 3 shows that the innovation performance index constructed using the scores of the first two principal components (Factor1 and Factor2), weighted by their respective contributions to the total variance explained. The weighting coefficients were the proportions of the variance contributed by each factor.

Table 4 shows the final composite score for innovation performance (innov_perf) calculated as the sum of the weighted factor scores. This score is intended to be a measure of a firm's innovation output, capturing both the introduction of new products and services, and improvements in processes leading to cost reductions.

Table 5. Descriptive Statistics

Variable	N	Mean	p50	SD	Min	Max
innov perf	2434	0	-0.508	0.753	-0.508	2.622
future conf	2434	4.246	4	0.875	1	5
risk	2434	5.839	6	2.513	0	10
stud lead	2434	0.978	1	1.257	0	6
charity	2434	0.526	1	0.499	0	1
npc cppcc	2434	0.058	0	0.345	0	3
gov exp	2434	0.05	0	0.218	0	1
pre non_agri	2434	1.485	1	2.292	0	32
gdp	2434	11.02	10.91	0.461	10.29	11.73
comp size	2434	1.319	1.099	1.35	0	13.82

Table 5 provides several key characteristics related to innovation performance and entrepreneurial traits. Innovation Performance (Innov Perf) has an average score of 0 with a standard deviation of 0.753, ranging from -0.508 to 2.622, indicating notable variability in innovation outcomes among the surveyed enterprises. Entrepreneurs' Risk tolerance averages 5.839 on a 0-10 scale, reflecting moderate risk acceptance. Regarding Student Leadership (Stud Lead), a mean score near one suggests that most entrepreneurs held at least one leadership position during their education. Charitable giving (Charity) is moderate, with an average score of 0.526. Entrepreneurs had an average of 1.5 years of non-agricultural work experience before starting their ventures (Pre Nonagri). The provincial GDP (GDP) score averages 11.02 with a narrow range, suggesting a relatively homogeneous economic environment across the sample. Finally, Company Size (Comp Size), measured by the number of employees, averages 1.319, indicating that most businesses are small to medium-sized enterprises.

These statistics provide foundational insights for the following empirical analysis and offer a preliminary understanding of the characteristics of the dataset. The next section details the empirical design, including the specification of statistical models and hypothesis-testing procedures.

D. Correlation Analysis

In the preliminary stage of the empirical investigation, correlation analysis was conducted to discern the linear relationships among the variables. This step is for identifying potential explanatory variables that are significantly associated with the dependent variable. Here, we examine the correlation coefficients between the independent variables and the dependent variable (innovative performance) as well as among the independent variables. And we see:

1) Positive correlations with innovative performance are observed for variables such as future confidence, risk, student leadership, charity, and company size.
2) Certain variables, such as government experience and pre-nonagricultural experience, show weaker but significant correlations with innovative performance.
3) The strongest correlation with innovative performance is seen with company size.

Table6. Correlation Analysis

	innov Perf	busi env	future	risk	stud lead	charity	npc	gov exp	pre	gdp	comp size
innov	1										
busi	0.036*	1									
future	0.120***	-0.096***	1								
risk	0.130***	-0.0090	0.180***	1							
stud	0.166***	0.109***	0.116***	0.115***	1						
charity	0.162***	-0.0070	0.109***	0.074***	0.173***	1					
npc	-0.0200	-	0.044**	0.063***	0.050**	0.058***	1				
gov	0.034*	-0.015	0.0220	0.0100	0.074***	0.0300	0.076***	1			
pre	0.094***	0.036*	0.0320	0.086***	0.0210	0.042**	-0.0220	0.124***	1		
gdp	-0.00200	0.816***	-	-	0.072***	-0.051**	-	-0.036*	0.0300	1	
comp	0.324***	0.071***	0.103***	0.123***	0.140***	0.159***	0.066***	0.038*	-	0.061***	1

t statistics in parentheses

$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

These correlations provide an initial understanding of how each variable might be related to innovation performance and incorporate them as independent variables or covariates.

Multicollinearity Test (VIF - Variance Inflation Factor)

Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly linear. We used the Variance Inflation Factor (VIF) to detect multicollinearity. VIF values greater than 10 are typically considered indicative of high multicollinearity.

Table 7 shows:

1) The highest VIF score was for stud_lead, but it was well below the threshold of 10, indicating no severe multicollinearity concerns.
2) A mean VIF of 1.05 suggests that, on average, the variables do not have strong multicollinearity.
3) All other variables have VIF values close to 1.05, indicating minimal multicollinearity concerns.

Table7. Multicollinearity Test

Variable	VIF	1/VIF
stud_lead	1.08	0.930006
comp_size	1.07	0.934174
future_conf	1.07	0.934675
risk	1.07	0.936172
charity	1.07	0.938179
gdp	1.05	0.951972
prenonagri	1.03	0.968039
gov_exp	1.03	0.971090
Npc_cppcc	1.03	0.972658
Mean VIF	1.05	

The correlation analysis and VIF test together suggest that our model is well-specified for a multiple regression analysis. The correlations indicate potential relationships between the variables and innovative performance, while the VIF results confirm that multicollinearity is unlikely to be a concern. It also provides confidence that each independent variable contributes uniquely to the prediction of innovative performance.

Results and Discussion

A. Multivariate Regression

H1 posits that early leadership experience as a student class leader positively relates to entrepreneurial innovation performance.

The main regression analysis provided compelling evidence to support H1. The coefficient of the student leadership experience (Stud_Lead) variable is positive and statistically significant, indicating a clear link between early leadership roles and enhanced innovation performance in entrepreneurial ventures.

The magnitude of the coefficient (0.060) suggests that each increment in early leadership experience (e.g., taking on an additional student leadership role) is associated with a 6% increase in the innovation performance metric. In addition, factors such as future_conf, risk, and charity also show significant positive relationships with innovation performance, suggesting that a combination of psychological traits and social engagement, alongside early leadership experiences, collectively contribute to entrepreneurial innovation.

Table8. Regression Results

	(1)
	innov_perf
future_conf	0.047***
	(3.16)
risk	0.018***
	(3.21)
stud_lead	0.060***
	(4.81)
charity	0.131***
	(4.54)
npc_cppcc	-0.121***
	(-3.20)
gov_exp	0.009
	(0.12)
pre_nonagri	0.031***
	(3.74)
gdp	-0.034
	(-1.09)
comp_size	0.163***
	(14.04)
_cons	-0.316
	(-0.88)
N	2434
R^2	0.150

t statistics in parenthese

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B. Interpretation of the Results

The positive relationship suggests that the skills, attitudes, and competencies developed through early leadership experiences have a lasting effect on an individual's ability to innovate. These experiences may lead to enhanced problem-solving capabilities, improved interpersonal skills, and a better understanding of group dynamics, all of which are crucial for fostering an innovative environment. Additionally, early leadership roles contribute to the psychological development of individuals by instilling confidence, resilience, and a proactive mindset—traits that are particularly important for entrepreneurs, who often face uncertainty and challenges in innovation. Engaging in leadership roles during formative years can also result in the development of expansive and diverse social networks, which provide valuable resources, information, and support, all essential for driving innovation and business growth. In conclusion, the analysis of H1 revealed a significant and positive association between student leadership experience and entrepreneurial innovation performance. This finding emphasizes the lasting impact of early leadership roles in shaping individuals' capabilities and perspectives, making them more conducive to innovative entrepreneurship.

C. Heterogeneity Analysis

H2: This phenomenon is stronger for older entrepreneurs compared to younger ones, indicating an age-related dynamic in the roles of early leadership experience.

The median age was 38.9 years. Entrepreneurs aged 38.9 years or younger were categorized as 'younger entrepreneurs'. This group represents individuals in the earlier stages of their entrepreneurial journey and is likely to experience different challenges and opportunities than their older counterparts. Conversely, entrepreneurs older than 38.9 years were classified as 'older entrepreneurs'. This category encapsulates individuals with potentially greater experience, established networks, and different perspectives on innovation and business growth.

Table 9. Mediating Effect of Charity, by Age

	(1)	(2)	(3)	(4)	(5)	(6)
	Innov_perf	Charity	Innov_perf	Innov_perf	Charity	Innov_perf
stud_lead	0.053***	0.058***	0.046***	0.078***	0.056***	0.072***
	(3.09)	(5.75)	(2.63)	(4.39)	(4.57)	(4.04)
future_conf	0.073***	0.023	0.069***	0.045**	0.051***	0.039**
	(3.19)	(1.36)	(3.06)	(2.30)	(3.46)	(2.00)
npc_cppcc	0.044	0.039	0.039	-0.096***	0.066**	-0.104***
	(0.29)	(0.62)	(0.27)	(-2.71)	(2.25)	(-2.87)
pre_nonagri	0.037***	0.011**	0.035***	0.020*	0.006	0.019*
	(3.17)	(2.13)	(3.02)	(1.86)	(0.77)	(1.84)
gdp	-0.047	-0.090***	-0.035	-0.056	-0.039	-0.052
	(-1.07)	(-3.09)	(-0.80)	(-1.32)	(-1.18)	(-1.22)
comp_size	0.178***	0.051***	0.171***	0.160***	0.048***	0.155***
	(10.47)	(5.07)	(10.00)	(10.02)	(4.59)	(9.70)
charity			0.133***			0.112***
			(3.17)			(2.92)
_cons	-0.050	1.301***	-0.224	0.027	0.577	-0.037
	(-0.10)	(3.83)	(-0.44)	(0.06)	(1.55)	(-0.08)
N	1312	1312	1312	1118	1118	1118
R^2	0.122	0.056	0.129	0.148	0.064	0.154

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Regression analysis from Table 9 to Table 12 revealed a significant positive relationship between early student leadership experience (stud_lead) and entrepreneurial innovation performance. Importantly, this relationship strengthens with entrepreneur age. For young entrepreneurs, as evidenced in Tables 9-12 (columns 1-3), the variable "stud_lead" (early student leadership experience) consistently demonstrates a significant positive relationship with `innov_perf` (innovationperformance).

Table10. No Mediating Effect of Government Job Experience, by Age

	(1) innov_perf	(2) gov_exp	(3) innov_perf	(4) innov_perfe	(5) gov_exp	(6) innov_perf
stud_lead	0.051***	0.013**	0.049***	0.078***	0.012*	0.079***
	(2.98)	(2.56)	(2.86)	(4.36)	(1.71)	(4.41)
trust	0.059	-0.006	0.060	0.061	-0.012	0.060
	(1.25)	(-0.51)	(1.26)	(1.43)	(-0.66)	(1.41)
loc_work	0.159***	0.011	0.157***	-0.062	0.026	-0.060
	(3.52)	(0.85)	(3.47)	(-1.59)	(1.54)	(-1.54)
future_conf	0.067***	0.003	0.066***	0.041**	-0.002	0.040**
	(2.92)	(0.61)	(2.88)	(2.06)	(-0.25)	(2.06)
npc_cppcc	0.051	-0.023***	0.056	-0.094***	0.047**	-0.090**
	(0.33)	(-4.15)	(0.36)	(-2.67)	(2.06)	(-2.55)
pre_nonagri	0.032***	0.013***	0.030***	0.023**	0.011**	0.024**
	(2.75)	(3.11)	(2.62)	(2.20)	(2.28)	(2.27)
gdp	-0.059	-0.022**	-0.055	-0.059	-0.012	-0.060
	(-1.34)	(-2.09)	(-1.25)	(-1.38)	(-0.72)	(-1.41)
comp_size	0.182***	0.009	0.180***	0.159***	0.003	0.159***
	(10.79)	(1.35)	(10.48)	(9.92)	(0.61)	(9.93)
gov_exp			0.179			-0.073
			(1.45)			(-0.94)
_cons	0.011	0.216*	-0.028	0.053	0.171	0.066
	(0.02)	(1.88)	(-0.06)	(0.11)	(0.88)	(0.13)
N	1312	1312	1312	1118	1118	1118
R^2	0.132	0.040	0.134	0.151	0.030	0.152

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table11. Mediating Effect of Confidence, by Age

	(1) innov_perf	(2) future_conf	(3) innov_perf	(4) innov_perf	(5) future_conf	(6) innov_perf
stud_lead	0.061***	0.106***	0.053***	0.080***	0.032	0.078***
	(3.61)	(6.99)	(3.09)	(4.46)	(1.38)	(4.39)
npc_cppcc	0.045	0.003	0.044	-0.092***	0.085*	-0.096***
	(0.29)	(0.02)	(0.29)	(-2.59)	(1.89)	(-2.71)
pre_nonagri	0.038***	0.017*	0.037***	0.020*	0.008	0.020*
	(3.26)	(1.91)	(3.17)	(1.93)	(0.57)	(1.86)
gdp	-0.070	-0.312***	-0.047	-0.065	-0.187***	-0.056
	(-1.61)	(-6.70)	(-1.07)	(-1.53)	(-3.09)	(-1.32)
comp_size	0.183***	0.074***	0.178***	0.162***	0.050**	0.160***
	(10.78)	(4.46)	(10.47)	(10.11)	(2.51)	(10.02)
future_conf			0.073***			0.045**
			(3.19)			(2.30)
_cons	0.492	7.474***	-0.050	0.305	6.161***	0.027
	(1.03)	(14.58)	(-0.10)	(0.65)	(9.26)	(0.06)
N	1312	1312	1312	1118	1118	1118
R^2	0.117	0.068	0.122	0.144	0.020	0.148

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Table12. Mediating Effect of risk aversion, by Age

	(1)	(2)	(3)	(4)	(5)	(6)
	innov_perf	risk	innov_perf	innov_perf	risk	innov_perf
stud_lead	0.053***	0.106**	0.051***	0.078***	0.160**	0.077***
	(3.09)	(2.26)	(2.92)	(4.39)	(2.47)	(4.32)
future_conf	0.073***	0.540***	0.059**	0.045**	0.303***	0.043**
	(3.19)	(5.74)	(2.56)	(2.30)	(3.27)	(2.19)
npc_cppcc	0.044	0.197	0.039	-0.096***	0.445***	-0.099***
	(0.29)	(0.66)	(0.27)	(-2.71)	(3.03)	(-2.79)
pre_nonagri	0.037***	0.037	0.036***	0.020*	0.149***	0.019*
	(3.17)	(1.44)	(3.11)	(1.86)	(3.96)	(1.76)
gdp	-0.047	-0.227*	-0.042	-0.056	-0.529***	-0.053
	(-1.07)	(-1.71)	(-0.94)	(-1.32)	(-3.14)	(-1.23)
comp_size	0.178***	0.073	0.176***	0.160***	0.274***	0.158***
	(10.47)	(1.53)	(10.39)	(10.02)	(4.93)	(9.86)
risk			0.025***			0.007
			(2.74)			(0.95)
_cons	-0.050	6.091***	-0.202	0.027	9.290***	-0.035
	(-0.10)	(3.76)	(-0.39)	(0.06)	(4.78)	(-0.07)
N	1312	1312	1312	1118	1118	1118
R^2	0.122	0.055	0.127	0.148	0.075	0.148

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The coefficients for this group range from 0.046 to 0.053. By contrast, for the cohort of older entrepreneurs (Tables 9-12, columns 4-6), the coefficient for `stud_lead` is more pronounced, ranging from 0.072 to 0.080. Such findings substantiate the hypothesis that the relate to of early leadership experiences not only persists but also intensifies with age, thus affirming H2.

D. Interpretation of Heterogeneity

From a life course perspective, as outlined by Elder and Jr. (1994), early life experiences such as student leadership play an evolving role throughout an individual's life. These early experiences accumulate over time, with their benefits becoming more pronounced as individuals age. For older entrepreneurs, the impact of early leadership experiences on innovation is more substantial, as these foundational experiences are further developed and integrated into their professional lives.

Baltes' (1987) theory of skill maturation supports this by suggesting that skills acquired in early life undergo refinement and application in increasingly complex settings, such as entrepreneurship. Over time, these foundational leadership skills mature and are integrated into an individual's broader professional experience. Older entrepreneurs, having had more time to refine and apply these skills, are better positioned to leverage them effectively in entrepreneurial contexts. In contrast, younger entrepreneurs, while possessing these skills, are still in the early stages of applying them, resulting in a positive but less pronounced influence on innovation.

Furthermore, Bourdieu's (1986) theory of social capital implies that networks established during early leadership roles expand and strengthen over time, providing older entrepreneurs with a more diverse and resourceful network to support innovation. Early leadership often serves as the foundation for social connections that, over time, broaden and deepen, becoming increasingly valuable for innovation efforts. Younger entrepreneurs, on the other hand, are still in the process of building their networks and may not yet fully capitalize on these connections for innovation.

Finally, Lerner's (1984) work on psychological development suggests that individuals continue to develop key psychological traits, such as confidence and proactiveness, throughout their lives. Early leadership roles foster these traits, and their influence compounds over time, resulting in a greater effect on innovation performance in older entrepreneurs. These psychological traits, developed through early leadership, become more influential in shaping innovation as entrepreneurs progress in their careers.

E. Mediating Pathway Effect

H3: For younger entrepreneurs, psychological traits (risk propensity, self-confidence, philanthropy) play a significant mediating role in innovation performance.

In examining the regression coefficients presented in Tables 9 to 12, distinct patterns of mediation emerge among younger entrepreneurs. Specifically, early leadership experience (stud_lead) robustly predicts innovation performance (Innov_perf), with psychological traits such as future confidence (future_conf), risk propensity (risk), and philanthropic inclination (charity) serving as significant mediators.

In Table 9, focusing on philanthropic inclination as a mediator, the direct effect of stud_lead on Innov_perf is significant with a coefficient of 0.053 ($t = 3.09$, $p < 0.01$) in Column (1). When charity is included as a mediator in Column (3), the coefficient of stud_lead decreases to 0.046 ($t = 2.63$, $p < 0.01$). Charity itself has a significant positive effect on Innov_perf with a coefficient of 0.133 ($t = 3.17$, $p < 0.01$). The decrease in the coefficient of stud_lead from 0.053 to 0.046 indicates that philanthropic inclination partially mediates the relationship between early leadership experience and innovation performance.

Similarly, in Table 11, which examines future confidence as a mediator, the initial coefficient of stud_lead on Innov_perf is 0.061 ($t = 3.61$, $p < 0.01$) in Column (1). With future_conf included in Column (3), the coefficient decreases to 0.053 ($t = 3.09$, $p < 0.01$). Future_conf significantly predicts Innov_perf with a coefficient of 0.073 ($t = 3.19$, $p < 0.01$). This reduction in the stud_lead coefficient indicates that future confidence partially mediates the relationship between early leadership experience and innovation performance.

In Table 12, addressing risk propensity as a mediator, the direct effect of stud_lead on Innov_perf is 0.053 ($t = 3.09$, $p < 0.01$) in Column (1). Upon including risk in Column (3), the coefficient of stud_lead slightly decreases to 0.051 ($t = 2.92$, $p < 0.01$), and risk has a significant positive effect on Innov_perf with a coefficient of 0.025 ($t = 2.74$, $p < 0.01$). This suggests that risk propensity partially mediates the impact of early leadership experience on innovation performance.

Conversely, prior governmental experience does not exhibit a significant mediating effect among younger entrepreneurs.As shown in Table 10, the coefficient of stud_lead on Innov_perf remains relatively unchanged from 0.051 ($t = 2.98$, $p < 0.01$) in Column (1) to 0.049 ($t = 2.86$, $p < 0.01$) when gov_exp is included in Column (3). Moreover, gov_exp itself does not have a statistically significant effect on Innov_perf (coefficient 0.179, $t = 1.45$, $p > 0.1$). This indicates that prior governmental experience does not significantly mediate the relationship between early leadership experience and innovation performance for younger entrepreneurs.

These findings collectively demonstrate that for younger entrepreneurs, psychological traits such as philanthropic

inclination, future confidence, and risk propensity significantly mediate the relationship between early leadership experience and innovation performance. The consistent decrease in the stud_lead coefficient upon the introduction of these mediators underscores their mediating roles. In contrast, prior governmental experience does not play a significant mediating role, suggesting that personal psychological characteristics are more influential in enhancing innovation performance among younger entrepreneurs.

F. Discussion of Pathway and Heterogeneity

Young entrepreneurs are in a key stage of psychological development. Theories by Lerner (1984) and Erikson (1968) highlight this period as crucial for forming identity and building confidence. Early leadership experiences interact with developing psychological traits related to an entrepreneurial mindset. Bandura's (1977) social learning theory suggests that early leadership experiences can boost self-efficacy. The significant positive link between future confidence and innovation suggests that self-efficacy and optimism about the future are important for younger entrepreneurs' innovative activities. For young entrepreneurs, early leadership roles likely provide positive experiences that strengthen confidence and willingness to engage in innovative efforts.

Risk-taking is a fundamental part of entrepreneurship, especially among younger entrepreneurs. According to Forlani and Mullins (2000), younger individuals often have a higher tendency to take risks, which can directly affect their approach to innovation. Early leadership roles may increase the willingness to engage in innovative risk-taking activities (Forlani & Mullins, 2000). This higher willingness to take risks serves as an important link between early leadership experience and innovation performance, leading to a more aggressive pursuit of new opportunities.

Charitable activities help build social connections and a public image (Bourdieu, 1986). For entrepreneurs, participating in charity can improve their reputation and provide networking opportunities that are important for innovation, especially at the beginning of a start-up. The significant mediating effect of philanthropic inclination suggests that early leadership experiences encourage charitable behavior, which then improves innovation performance by broadening social networks and access to resources.

On the other hand, prior government experience does not have a significant mediating effect among younger entrepreneurs. While early career experience in government roles can provide useful insights and skills relevant to entrepreneurial activities (Baum & Locke, 2004), our findings show that such experiences do not significantly mediate the relationship between early leadership experience and innovation performance for younger entrepreneurs. This suggests that personal psychological traits are more influential than prior government roles in enhancing innovation performance within this group.

Improving innovation in young entrepreneurs through psychological traits involves several factors. The mediating effects of psychological traits on the relationship between early leadership experience and innovation in young entrepreneurs support H3.

H4: In contrast, for older entrepreneurs, these mediating effects diminish or change, reflecting different mechanisms driving innovation at different age stages.

Conversely, in the older entrepreneur cohort, while early leadership experience continues to be a significant predictor of innovation, the mediating effect of future confidence and risk propensity diminishes, thus demonstrating H4. This is evidenced by the smaller changes in the stud_lead coefficient upon the introduction of future_conf and risk. Philanthropic inclination maintains a significant relationship with innovation performance. However, it does not exhibit a clear mediating effect as it does with younger entrepreneurs, as shown by the negligible change in the stud-lead coefficient. This pattern indicates that the pathways through which early leadership experiences translate into innovative activities in

later life stages are less reliant on individual traits and experiences.

The role of early leadership on innovation performance persisted significantly for older entrepreneurs, albeit without the mediating effect of future_conf, risk, or gov_exp. This suggests that, while early leadership forms a strong foundation for innovation, its role in later years becomes more direct and less dependent on these specific traits. The concept of cumulative advantage (DiPrete & Eirich, 2006) suggests that as people age, the benefits accrued from early successes can compound, leading older entrepreneurs to rely less on the individual traits that initially propelled them, and more on the resources and reputation they have accumulated. This cumulative advantage (DiPrete & Eirich, 2006) means that their approach to innovation draws from a more diverse knowledge, transcending the role of any single trait or experience from the past. The diminishing role of earlier psychological traits and external experiences aligns with theories of the life course and human capital accumulation. As entrepreneurs age, the dynamics of innovation shift towards utilizing a more comprehensive set of resources and experiences accumulated over their lifetime. Moreover, in their early career, young entrepreneurs might lean heavily on traits such as risk-taking or self-confidence developed through student leadership roles. Their initial successes and public image may be partly attributed to these traits. However, as they mature, their entrepreneurial identity evolves. They no longer rely solely on the dynamism of their early traits; their brand and business identity have grown beyond these initial characteristics.

The diminished mediating role of risk propensity in older entrepreneurs aligns with the findings of Carland et al. (1984) that mature businesses may exhibit less risk-taking behavior as they shift their focus towards sustainability and growth. The lack of a significant change in the stud-lead coefficient upon the introduction of risk and gov_exp in the models for older entrepreneurs suggests that the direct effects of early leadership do not flow through these channels as they do with younger entrepreneurs. This may reflect a shift towards more conservative strategies or a reliance on established networks and resources that come with age and experience. In addition, younger entrepreneurs may not leverage governmental experience to navigate regulations and secure early-stage opportunities, older entrepreneurs are likely to have established such pathways and may no longer benefit from the specific advantages that governmental experience provides. Alternatively, it is plausible that the reduced shape aligns with the concept of "absorptive capacity" proposed by Cohen and Levinthal (1990), where the ability to recognize the value of new information, assimilate it, and apply it to commercial ends is contingent on prior related knowledge. As older entrepreneurs have amassed a wealth of knowledge, the incremental value of government experience on innovation may be less significant.

In addition, older entrepreneurs often have a well-established sense of self-efficacy and clear understanding of their business landscape. The need for strong future confidence to drive innovation may diminish, as they rely more on their accumulated experience and proven business acumen. Welter (2011) discusses how the context of entrepreneurship changes with age, affecting an entrepreneur's reliance on self-confidence in innovation.

In summary, the data suggest that early leadership experience continues to directly relate to innovation in older entrepreneurs, but the mechanisms by which this occurs shift with age. While younger entrepreneurs benefit from the mediating effects of traits such as future confidence and risk taking, these pathways appear to diminish for older entrepreneurs. Instead, the continued significance of philanthropy in the older cohort points to the lasting importance of social capital and its contribution to innovation.

G. Robustness Checks

To ensure the integrity and reliability of our findings, we conduct a series of robustness checks. These checks were designed to test the stability of the regression results against alternative specifications and potential outliers that may relate to the estimated relationships.

1. **Alternative Indicator Substitution**

To ascertain the robustness of our primary innovation performance measure, we substituted the original index with a secondary index, focusing specifically on product innovation. This secondary index captures a narrower scope of innovation, allowing us to discern whether our primary findings are sensitive to the aspect of the innovation being measured.

From Table 13 column (1), we see that the positive and statistically significant coefficient for stud_lead remains robust, reinforcing the assertion that early leadership experience is a consistent predictor of innovation across measures.

2. **Exclusion of Special Administrative Regions**

Recognizing the unique economic and administrative structures of direct-controlled municipalities, we performed an additional regression analysis, excluding data from Shanghai. The rationale behind this exclusion was to eliminate any potential bias that these unique entities might introduce, providing a clearer picture of the relationship under study across more homogeneous regions. From Table 13 column (2) we see that this excision does not attenuate the statistical significance of stud_lead, reinforcing the assertion that outliers do not unduly relate to its effect on innovation.

Table13. Robustness Checks

	(1) F1	(2) Innov_perf(SH excluded)
stud_lead	0.116***	0.115***
	(6.92)	(8.18)
_cons	-0.114***	-0.090***
	(-4.67)	(-4.62)
N	2434	2128
R^2	0.021	0.035

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

H. Fixed Effects and Tackling Endogeneity

The use of fixed effects to control for unobserved heterogeneity is well documented in econometrics literature (Wooldridge, 2010). In our empirical investigation of the role of student leadership experience (stud_lead) on firm innovation performance (innov_perf), we confront the endogeneity challenge. Fixed-effects models are used to control for unobservable variables that could potentially bias the estimated relationship between the independent and dependent variables. The choice of fixed effects is grounded in econometric literature, as it allows us to control for unobservable variables that could bias our estimates, such as specific regional policies or industry-specific trends (Wooldridge, 2010). Additionally, we performed several robustness checks, including alternative indicator substitution and the exclusion of data from special administrative regions like Shanghai. These checks confirmed the stability of our results, with the positive and statistically significant coefficient for early leadership experience (stud_lead) remaining robust across different specifications. These unobserved variables might vary across entities (such as provinces or industries) but remain constant over time for each entity. For example, specific regional policies or industry-specific trends could relate to innovation regardless of the firm's internal characteristics, such as leadership experiences. Moreover, the significance of controlling for both industry and regional effects in firm-level studies is emphasized in studies such as Porter's (1990) examination of competitive strategy. When considering innovation performance as the dependent variable, fixed effects help control for unobserved heterogeneity across provinces and industries, which might independently affect a firm's innovation capacity.

When considering the inclusion of regional and industry fixed effects in an econometric model, the equation can be expanded to control for these variables: Fixed effects are typically represented as dummy variables that capture the unique, time-invariant characteristics of each region and industry. The regression model is expressed as follows:

$$Innov\_Perf_i=\beta_0+\beta_1\times Trust_i+\beta_2\times Future\_Conf_i+\beta_3\times Risk_i+\beta_4\times Stud\_Lead_i+\beta_5\times Charity_i+\beta_6\times NPC\_CPPCC_i+\beta_7 \times Gov\_Exp_i+\beta_8\times Pre\_NonAgri_i+\beta_9\times Loc\_Work_i+\beta_{10}\times GDP_i+\beta_{11}\times Comp\_Size_i+\sum\lambda_j\times Area\_FE_j+\sum\gamma_k\times Industry\_FE_k+\epsilon_i$$

Our model introduces fixed effects for the provinces (Iprovince–*) and industries (Iindustry–*). This approach is designed to control for time-invariant characteristics unique to each province and industry, such as regional economic policies, local market conditions, or industry-specific technological trends, which could confound the relationship between stud_lead and _perf. By incorporating these fixed effects, the model accounts for unobservable factors that may simultaneously relate to the development of both student leadership qualities and innovation outcomes. This adjustment is crucial for isolating the specific role of stud_lead on innov_perf, beyond general environmental and sectoral influences.

The results from the fixed-effects regression model (Table14) provide revelations, and the coefficient for stud_lead remains positively and significant ($\beta = 0.059$, $p < 0.01$), suggesting a robust relationship with innov_perf, even after accounting for the fixed effects. This lends credence to the hypothesis that student leadership experience plays a substantial role in enhancing a firm's innovation capacity. Other variables, such as future_conf, risk, and charity, also show significant coefficients, indicating their respective contributions to innovation performance. However, the key interest lies in the persistence of the stud-lead effect, which underscores the unique role of early leadership experiences in shaping innovative outcomes.

Table14. Fixed Effect

	(1) innov_perf	(1) innov_perf
trust	0.043	0.043
	(1.36)	(1.42)
future_conf	0.049***	0.047***
	(3.26)	(3.16)
risk	0.018***	0.018***
	(3.16)	(3.21)
stud_lead	0.059***	0.060***
	(4.78)	(4.81)
charity	0.130***	0.131***
	(4.53)	(4.54)
npc_cppcc	-0.091**	-0.121***
	(-2.33)	(-3.20)
gov_exp	0.041	0.009
	(0.59)	(0.12)
pre_nonagri	0.028***	0.031***
	(3.41)	(3.74)
gdp	-0.096	-0.034
	(-1.56)	(-1.09)
comp_size	0.170***	0.163***
	(14.02)	(14.04)
_cons	0.117	-0.316
	(0.16)	(-0.88)
Industry FE	Yes	YES
Regional	YES	YES
Indus_Dum	Controlled	Controlled
Regin_Dum	Controlled	Controlled
N	2434	2434
R2	0.185	0.150

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

This study investigates the intersection of early leadership experience and entrepreneurial innovation, with a specific focus on the dynamics across different age groups. At the heart of this research is an exploration of how leadership roles during the educational phase, combined with psychological traits, particularly risk propensity, self-confidence, and philanthropic tendencies, mediate this relationship. This unique angle addresses a notable gap in the literature, which has not fully explored the age-specific shapes of these early experiences. The inclusion of regional and industry fixed effects in the methodology enhances the precision of our findings.

Our study contributes to entrepreneurial literature by shedding light on the less-explored aspect of how early life experiences relate to an entrepreneur's innovative capabilities. These findings underscore the importance of nurturing

leadership qualities and psychological resilience from a young age, highlighting their long-term shape on entrepreneurial success.

Our findings on the role of philanthropic inclination in innovation underscore the value of building social capital. This suggests that educational and professional development programs should include components that encourage networking, community engagement, and social ties, which are crucial for entrepreneurial success. The enduring relationship of early leadership experiences on innovation highlights the importance of investing in human capital, particularly through educational and professional development programs that emphasize early leadership development and psychological resilience. For policymakers, this suggests a need to design initiatives that cultivate these traits from a young age, ensuring that future entrepreneurs are well-equipped to drive innovation. For business leaders, fostering a workplace culture that supports continuous learning, mentorship, and early leadership opportunities can significantly contribute to a company's innovation capacity.

However, this study had several limitations. The reliance on self-reported data from the ESIEC survey may introduce biases, as respondents' perceptions may not accurately reflect their actual experiences or traits. In addition, the cross-sectional nature of the data limits our ability to infer causality. By addressing these limitations, future studies can provide a more robust understanding of the relationship between early leadership experiences and innovation. Future research could benefit from longitudinal studies to track the evolution of these traits and experiences over time, and their direct shape on innovation. Another avenue for further research could involve a more diverse sample across different cultural contexts, as cultural background may significantly relate to the development of leadership traits and entrepreneurial innovation.

The implications of this study are manifold. For educators and policymakers, there is a clear direction for embedding leadership development and psychological resilience into educational frameworks. This study highlights the value of nurturing social networks and investing in continuous learning and personal development for entrepreneurs and business leaders.

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