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The Impact of University Basic Research on Regional Economic Growth

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ABSTRACT

Universities are major contributors to basic research, and their roles in knowledge creation and human capital development are widely recognized as fundamental drivers of regional economic growth. Whether these functions are effectively transformed into economic performance across Chinese provinces, however, remains an open empirical question. Using panel data from 30 Chinese provinces, this study systematically investigates the impact of university basic research on regional economic growth. Baseline estimates are obtained using a two-way fixed-effects model and are validated through a series of robustness checks, including alternative variable specifications, lagged models, and system GMM estimation. The findings show no statistically significant relationship between university basic research and regional economic growth during the sample period. Mechanism analysis further indicates that university basic research does not significantly enhance human capital accumulation, technological innovation, or entrepreneurship, despite the fact that all three factors contribute positively to regional economic growth. These results suggest the existence of an upstream bottleneck that limits the transformation of academic knowledge into economic value. In addition, government intervention significantly weakens the relationship between university basic research and human capital accumulation. Overall, the findings highlight institutional barriers to the economic commercialization of university research in China and provide policy implications for strengthening public governance, research training, and knowledge transfer mechanisms.

1. Introduction

The Third Plenary Session of the 20th Central Committee of the Communist Party of China called for strengthening organized basic research and increasing the share of science and technology expenditure devoted to basic research [1]. China has expanded its investment in basic research rapidly in recent years. China's R&D intensity also approached or exceeded the OECD average, depending on the reference year and statistical definition [2]. At a symposium on strengthening basic research in April 2026, government in China emphasized the foundational role of basic research in

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the scientific and technological innovation system and its importance for addressing technological challenges [3]. Universities are the principal performers of basic research. They produce and disseminate knowledge and cultivate highly skilled graduates with innovative thinking and practical capabilities, thereby providing sustained support for high-quality economic development [4]. As the share of university basic research funding continues to rise, assessing its economic effects is essential for evaluating research performance, improving resource allocation, and identifying weaknesses in China's university‑industry‑research collaboration system.

Existing research on university basic research has largely focused on input‑output efficiency and performance evaluation. Using data envelopment analysis, Xu and Zhi [5] find that the research efficiency of universities in 29 Chinese provinces increased substantially but remained low overall. Jiang *et al.,* [6] similarly report that the research efficiency of Project 211 universities was lower than that of Project 985 and other universities, with substantial regional heterogeneity. Regarding innovation performance, the literature generally argues that basic research expands the knowledge frontier and supports product innovation and productivity growth by accelerating technological renewal [7]. Chen and Xu [8] find that university basic research significantly improves both the quantity and quality of regional technological innovation in China. University science may also promote economic growth through knowledge spillovers [9], which are often geographically localized. Using university relocation in China as a quasi-natural experiment, Zhong [10] shows that microscopic geographic proximity facilitates the diffusion of university research to nearby firms. The economic returns to university research nevertheless vary across countries at different stages of development [11, 12]. Ntuli *et al.,* [12] find unidirectional causality from research output to economic growth in only four of 34 OECD countries, reverse causality in eight countries, and no significant causal relationship in the remaining 22. Using a PVAR model and data from 30 Chinese provinces, Liu and Shen [13] find no evidence that either university basic research or applied research Granger-causes economic growth.

As China deepens the integration of education, science and technology, and talent development, it has risen to tenth place in the Global Innovation Index and remains the only middle-income economy among the global top ten [14]. According to the Nature Index 2026 country and institutional rankings, China has achieved a leading position in selected indicators of high-quality natural-science research output [15]. A report released by the Chinese Academy of Sciences further notes China’s strong performance in overall basic-research output and in several major scientific fields [16]. These developments indicate the growing global influence of Chinese university research. Nevertheless, evidence on its economic performance remains limited, particularly regarding the mechanisms through which university-generated knowledge is converted into regional economic outcomes.

The marginal contributions of this study mainly lie in the following three aspects. First, it measures university basic research in terms of both quantity and quality, using the number of Web of Science (WoS) publications and their citations per student. Neither measure has a statistically significant direct effect on regional economic growth. This finding suggests that, in developing economies, expanding publicly funded research output alone may be insufficient to generate the expected economic returns; institutional conditions and regional absorptive capacity also matter. Second, the study examines three potential transmission channels: human capital accumulation, technological innovation, and entrepreneurship. University basic research does not significantly improve any of these mediators, whereas each mediator independently promotes regional growth. The evidence therefore identifies an upstream bottleneck between knowledge production and economic application. Third, the analysis shows that government intervention negatively moderates the effect of basic research on human capital, highlighting the institutional environment as an important boundary condition for the economic translation of university research.

The remainder of the paper is organized as follows. Section 2 develops the theoretical framework. Section 3 describes the data, variables, and empirical models. Section 4 presents the baseline results, robustness checks, and dynamic analysis. Section 5 examines the mediation mechanisms, and Section 6 investigates the moderating effect of government intervention. Section 7 concludes and discusses policy implications.

2. Theoretical Framework

The linear model of innovation conceptualizes the relationship between science, technology, and economic growth as a sequence extending from basic research through applied research and experimental development to production and commercialization [17]. Basic research lies at the beginning of this innovation chain. Its primary purpose is to uncover the underlying nature of observable phenomena and the fundamental laws governing them, typically through systematic theoretical or experimental inquiry [18]. Because basic research generates positive externalities and non-rival knowledge, universities and public research institutes are its principal performers. Their organizational missions nevertheless differ. Universities rely on disciplinary breadth and academic freedom and therefore allow researchers considerable scope to pursue curiosity-driven inquiry. Public research institutes are more commonly organized around national strategic priorities, mission-oriented programs, and specified objectives [19]. As a country approaches the technological frontier and faces greater technological uncertainty, universities become increasingly important to both the basic research system and long-run growth.

Although universities are widely viewed as engines of local economic development, the empirical evidence is mixed. Their growth effects depend on prevailing socioeconomic conditions, industrial structure, technological paradigms, and changes in university functions. Goldstein and Renault [20], for example, find that the contribution of US universities to local development was modest during 1969–1986 but became significantly stronger during 1986–1998, suggesting that the benefits of university research become more visible in a mature knowledge economy. Effects also differ across fields. Pinto and Teixeira [21] show that research in both capital-good fields, such as the physical and life sciences, and final-good fields, such as clinical medicine and the humanities, promotes growth. The estimated effect is larger for capital-good fields because their knowledge has broader applications.

Universities perform multiple functions, including education, research, public service, and cultural development. Education is central to human capital formation. University basic research may promote regional growth by improving human capital through two main routes. First, graduates trained through research enter industry with frontier scientific knowledge and the capacity to solve complex problems. Second, participation in industry-related projects provides students with practical experience and occupational skills valued by firms [22]. Endogenous growth theory identifies human capital accumulation as a fundamental driver of growth [17, 18]. This effect is not automatic, however. It may be substantially weakened when university curricula are poorly aligned with industrial needs or when research and teaching remain disconnected [23].

As a source of new knowledge, university basic research provides foundational concepts, theoretical reserves, and knowledge spillovers that support subsequent technological development and industrial innovation [22]. It may therefore affect regional growth indirectly through technological innovation. Akcigit *et al.,* [24] show within an extended endogenous-growth framework that basic research is a cornerstone of regional innovation systems and can raise both innovation output and innovative capacity. The realization of such spillovers, however, depends heavily on firms' absorptive capacity and the quality of the surrounding innovation environment [25, 26]. Moreover, although basic research may increase technological progress and total factor productivity over the long run, its economic benefits are often difficult to observe in the short run [27].

University basic research may also lower the technological barriers, uncertainty, and costs facing innovative entrepreneurs. Knowledge spillovers can stimulate entrepreneurial experimentation while research-based education supplies the human capital needed for entrepreneurship [28]. Cross-regional evidence further identifies entrepreneurship as an important source of regional development differences [29]. University science provides a knowledge and technology base for entrepreneurial activity, but its contribution remains contingent on the higher education system, research evaluation mechanisms, and the regional innovation climate [30]. Figure 1 summarizes the proposed transmission channels.

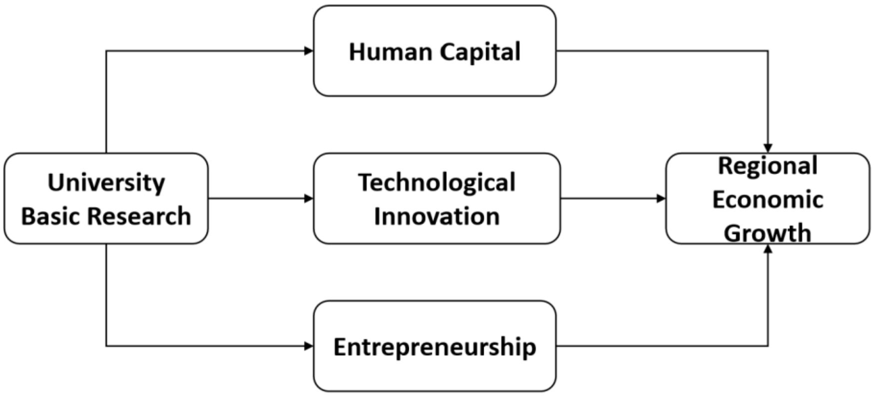

Fig. 1. Conceptual framework and transmission mechanisms

3. Data and Methods

3.1 Variable Selection and Measurement

The dependent variable is regional economic growth. Following Kachunga *et al.,* [31], the baseline measure is real gross regional product (GRP) per capita, adjusted to constant 2000 prices to eliminate the effects of inflation. Although GRP per capita captures the overall level of regional production, it does not necessarily reflect the economic resources ultimately available to households. Disposable income, by contrast, represents the income available to residents for consumption and saving after accounting for taxes, social contributions, and transfer payments. Fleurbaey [32] argues that material living standards should be evaluated using household income and consumption rather than production alone. Similarly, the OECD [33] identifies household disposable income as a core indicator of material well-being. Accordingly, real disposable income per capita is employed as an alternative dependent variable in the robustness analysis, thereby assessing regional economic performance from a household-income perspective.

The core explanatory variable is university basic research output. Academic publications constitute one of the principal observable outputs of original research and knowledge production [34]. Because publications indexed in the Web of Science (WoS) are subject to recognized academic standards and provide internationally comparable information on scientific output, university basic research is measured by the number of WoS-indexed publications per student. To account for differences in the scholarly influence and quality of research output, the number of WoS citations per student is used as an alternative measure in the robustness analysis.

Three potential mediating variables are considered: human capital, technological innovation, and entrepreneurship. Human capital is measured by the gross enrollment ratio in higher education, which reflects the extent of regional participation in higher education and the potential accumulation of highly educated labor. This measurement is consistent with endogenous growth theory, which regards human capital as a critical channel through which knowledge is transformed into productive capacity and sustained economic growth [18]. Following Jiang *et al.,* [35], technological innovation is measured by the number of granted patents per capita. Entrepreneurship is measured by the number of firms per 10,000 residents. This indicator captures regional entrepreneurial activity and the capacity of market actors to commercialize knowledge, establish new businesses, and convert technological opportunities into economic outcomes.

The analysis also controls for a set of regional socioeconomic characteristics that may simultaneously influence university research activities and economic growth. These include fixed-asset investment, household consumption, industrial structure, population size, trade openness, and government intervention. Table 1 presents the definitions, measurements, and supporting references for all variables.

Table 1
Variable definitions and measurement

Variable category	Variable	Measurement	Ref.
Dependent variable	Regional economic growth	GRP per capita	[31]
		Disposable income per capita	[32,33]
Core explanatory variable	University basic research	WoS publications per student	[34]
		WoS citations per student	[36]
Mediating variable	Human capital	Gross enrollment ratio in higher education	[37]
	Technological innovation	Granted patents per capita	[35]
	Entrepreneurship	Number of firms per 10,000 residents	[38]
Control variable	Fixed-asset investment	Fixed-asset investment as a share of GDP	[39]
	Household consumption	Household consumption expenditure as a share of GDP	[40]
	Industrial structure	Value added of the secondary and tertiary sectors as a share of GDP	[41]
	Population size	Year-end permanent resident population	[42]
	Trade openness	Total imports and exports as a share of GDP	[39]
	Government intervention	Government fiscal expenditure as a share of GDP	[43]

Table 2 reports descriptive statistics for the 720 province-year observations. The variables display substantial variation across provinces and over time, providing an adequate empirical basis for the subsequent analysis.

Pearson correlation coefficients and variance inflation factors (VIFs) are employed to examine pairwise correlations and potential multicollinearity, respectively. Trade openness is moderately correlated with population size and government expenditure, with correlation coefficients of 0.6449 and 0.5661, respectively. Its correlation with the core explanatory variable, university basic research, is 0.5542. The VIF values range from 1.24 to 2.64, with trade openness having the highest value. Because the maximum VIF is well below the commonly used thresholds of 5 and 10, multicollinearity is unlikely to pose a serious concern in the subsequent estimations.

Table 2
Descriptive statistics

Variable	Symbol	N	Mean	SD	Min
GRP per capita	pergdp	720	9.956	0.754	7.916
Disposable income per capita	income	720	9.490	0.811	7.736
WoS publications per student	paper	720	4.051	1.198	0.555
WoS citations per student	cite	720	7.212	1.299	2.746
Human capital	edu	720	1.720	0.803	0.213
Granted patents per capita	perpat	720	0.378	1.662	-3.078
Entrepreneurship	perfirm	720	-0.349	1.199	-3.268
Fixed-asset investment	fixed	720	99.026	54.986	25.725
Household consumption	consum	720	37.314	6.593	18.114
Industrial structure	indus	720	41.982	8.224	14.912
Population size	pop	720	5.436	1.273	1.968
Trade openness	open	720	3.206	0.981	0.261
Government expenditure	gov	720	7.495	2.747	3.141

3.2 Model Specification

To estimate the effect of university basic research on regional economic growth, this study employs a two-way fixed-effects model that controls for time-invariant provincial heterogeneity and common shocks over time through province and year fixed effects, respectively:

$$pergdp_{i,t} = \alpha_0 + \alpha_1 paper_{i,t} + \sum_{k=1}^{n} \beta_k \, Controls_{k,i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \tag{1}$$

where $\mathrm{pergdp_{it}}$ denotes the natural logarithm of real GRP per capita for province i in year t, and $\mathrm{paper_{it}}$ measures university basic research output, defined as the natural logarithm of WoS-indexed publications per student. $\mathrm{Controls_{it}}$ is a vector of time-varying provincial characteristics, including fixed-asset $\mathrm{investment(fixed_{it})}$, househol $\mathrm{consumption(consum_{it})}$, industrial $\mathrm{structure(indus_{it})}$, $\mathrm{populationsize(pop_{it})}$, trade $\mathrm{openness(open_{it})}$, and government $\mathrm{expenditure(gov_{it})}$. μ_i and λ_t represent province fixed effects and year fixed effects respectively, while ε_{it} is the idiosyncratic error term.

4. Empirical Results

4.1 Baseline Results

A stepwise estimation strategy is employed. Column (1) includes year fixed effects but no control variables. Column (2) further incorporates province fixed effects, while column (3) adds the full set of control variables to the two-way fixed-effects specification. The estimation results are presented in Table 3.

In column (1), the estimated coefficient on university basic research is 0.0075 ($p = 0.860$) and is not statistically significant. After province fixed effects are introduced in column (2), the coefficient becomes −0.0165 ($p = 0.706$) but remains insignificant. When the full set of control variables is added in column (3), the coefficient changes to 0.017 ($p = 0.525$) and continues to be statistically indistinguishable from zero. Taken together, these results provide no evidence of a statistically significant direct relationship between university basic research and regional economic growth during the sample period, even after controlling for time-invariant provincial heterogeneity, common temporal shocks, and observed regional characteristics.

Table 3
Baseline estimates of the effect of university basic research on regional economic growth

Variable	（1） pergdp	（2） pergdp	（3） pergdp
paper	0.0075	-0.0165	0.017
	(0.0426)	(0.0434)	(0.027)
fixed			0.0003
			(0.0004)
consum			0.005***
			(0.002)
indus			0.008***
			(0.002)
pop			-0.830***
			(0.149)
open			0.027
			(0.032)
gov			-0.007
			(0.006)
Constant	8.868***	8.940***	12.714***
	(0.156)	(0.140)	(0.749)
Province fixed effects	No	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	720	720	720
Within R^2	0.977	0.977	0.991

4.2 Robustness Checks
4.2.1 Alternative Measures

Two robustness checks are conducted using alternative variable measures. First, per capita disposable income is used as an alternative measure of regional economic growth. As shown in column (1) of Table 4, the estimated coefficient on university basic research is 0.023 ($p = 0.190$) and is not statistically significant. Second, WoS citations per student are used in place of publication counts to measure university basic research. The corresponding coefficient reported in column (2) is 0.024 ($p = 0.283$), which is likewise statistically insignificant. These findings are consistent with the baseline results, suggesting that the main conclusion remains robust to alternative measures of both regional economic growth and university basic research.

4.2.2 Lagged Effects

The economic returns to basic research may emerge only after a lengthy process of knowledge production, diffusion, and application. Table 5 therefore introduces one- to five-year lags of the core explanatory variable. None of the lagged coefficients is statistically significant at the 10% level. The baseline conclusion is thus robust to allowing for medium-term delays in the effects of university basic research.

Table 4
Robustness checks using alternative variables

Variable	(1) Disposable income as the dependent variable	(2) Citations as the core explanatory variable
paper	0.023	
	(0.017)	
pergdp		0.024
		(0.02)
Controls	Yes	Yes
Province fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	720	720
Within R^2	0.998	0.991

Table 5
Robustness checks using lagged university basic research

Variable	(1) One-year lag	(2) Two-year lag	(3) Three-year lag	(4) Four-year lag	(5) Five-year lag
pergdp	0.014	0.011	0.010	0.010	0.009
	(0.026)	(0.026)	(0.025)	(0.025)	(0.023)
Controls	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	690	660	630	600	570
Within R^2	0.991	0.991	0.991	0.991	0.991
p-value	0.582	0.66	0.690	0.701	0.693

4.2.3 System GMM Estimation

A two-step system GMM estimator is used to address potential dynamic endogeneity. As reported in Table 6, the coefficient on university basic research remains statistically insignificant (Table 7). The Wald test rejects the null of joint insignificance (p=0.000). Although the AR(2) test is significant, the model is estimated using instruments lagged three periods or more, and the AR(3) test does not indicate higher-order serial correlation. The Hansen test does not reject the joint validity of the instrument set. The system-GMM estimates therefore do not overturn the baseline finding, although the results should be interpreted with caution.

Table 6
Two-step system GMM estimates

Variable	Coefficient	Corrected robust standard error	z-statistic	P>|z|
L2.pergdp	1.115***	0.200	5.57	0.000
paper	-0.113	0.133	-0.85	0.396
fixed	-0.0001	0.0005	-0.19	0.849
consum	0.002	0.003	0.81	0.420

Table 6
Continued

Variable	Coefficient	Corrected robust standard error	z-statistic	P>|z|
indus	0.005	0.003	1.40	0.161
pop	0.017	0.030	0.59	0.556
open	-0.001	0.036	-0.04	0.971
gov	-0.001	0.014	-0.14	0.887
Constant	-0.878	1.448	-0.61	0.544

Table 7
Diagnostic tests for the dynamic panel model

Diagnostic	Value
Observations	660
Number of provinces	30
Wald test p-value	0.000
AR(1) p-value	0.170
AR(2) p-value	0.011
AR(3) p-value	0.323
Hansen test p-value	0.153

4.3 Dynamic Analysis Using a Panel Vector Autoregressive Model
4.3.1 Model Specification

The baseline and robustness results reveal no significant direct relationship between university basic research and regional economic growth. To capture potential dynamic interactions and transmission mechanisms, this study employs a panel vector autoregressive (PVAR) model and uses impulse response functions to assess how regional economic growth and the potential mediators respond to shocks in university basic research. The PVAR model is specified as follows

$$\mathrm{Z}_{\mathrm{it}}=\delta_0+\sum_{\mathrm{p}=1}^{\mathrm{n}} A_{\mathrm{p}}\, \mathrm{Z}_{\text{it-p}} + \mu_i+\varepsilon_{it} \tag{2}$$

where Z_{it} is a vector of endogenous variables comprising university basic research, regional economic growth, human capital, technological innovation, and entrepreneurship. P denotes the selected lag order, and A_{p} represents the matrix of coefficients associated with the pth lag of the endogenous variables. Province fixed effects are denoted by μ_i, while ε_{it} represents the vector of idiosyncratic disturbances. To reduce the influence of extreme observations, the core variables are winsorized at the 1st and 99th percentiles.

4.3.2 Panel Unit-Root Tests

Both the LLC homogeneous panel unit-root test and the IPS heterogeneous panel unit-root test are applied. As shown in Table 8, all endogenous variables reject the null hypothesis of a unit root at the 1% level and therefore satisfy the stationarity requirement for PVAR estimation.

Table 8
LLC and IPS panel unit-root tests

Variable	Test	Statistic	p-value	Conclusion
pergdp	LLC	-16.5104	0.0000	Stationary
	IPS	-12.4906	0.0000	Stationary
Δpaper	LLC	-7.3979	0.0000	Stationary
	IPS	-11.0251	0.0000	Stationary
Δedu	LLC	-5.8923	0.0000	Stationary
	IPS	-2.7854	0.0027	Stationary
$\Delta perpat$	LLC	-5.2072	0.0000	Stationary
	IPS	-11.3159	0.0000	Stationary
$\Delta perfirm$	LLC	-6.1313	0.0000	Stationary
	IPS	-8.5429	0.0000	Stationary

4.3.3 Impulse Response Analysis

Generalized impulse response functions are generated over a ten-period horizon using Monte Carlo simulations, Figure 2. This approach reduces sensitivity to variable ordering. The confidence interval for the response of regional economic growth to a positive university basic research shock crosses zero throughout the horizon, indicating that neither the short-run nor the longer-run response is statistically significant. The dynamic evidence is therefore consistent with the baseline estimates.

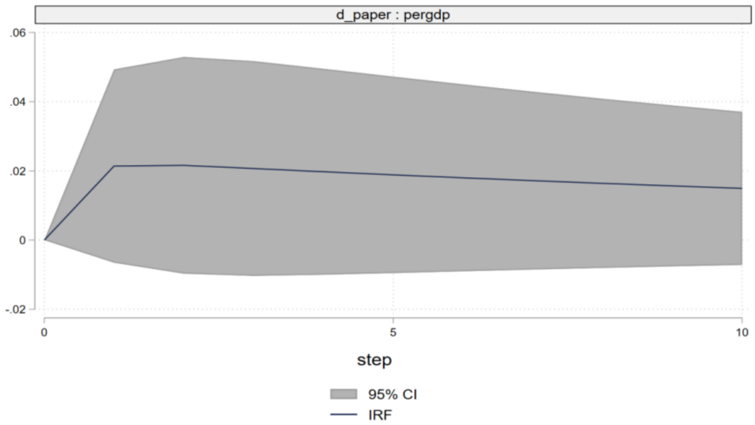

Fig. 2. Generalized impulse response function

5. Mechanism Analysis

5.1 Mediation Model

To investigate the potential transmission mechanisms through which university basic research affects regional economic growth, this study estimates a series of recursive mediation models focusing on human capital accumulation, technological innovation, and entrepreneurship.

$$M_{i,t}=\gamma_0+\gamma_1 paper_{i,t}+\sum_{k=1}^{n}\beta_k\, Controls_{k,i,t}+\mu_i+\lambda_t+\varepsilon_{i,t} \tag{3}$$

$$pergdp_{i,t}=\delta_0+paper_{i,t}+\delta_2 M_{i,t}+\sum_{k=1}^{n}\beta_k\, Controls_{k,i,t}+\mu_i+\lambda_t+\varepsilon_{i,t} \tag{4}$$

where $M_{i,t}$ denotes the mediator, measured alternatively by human capital, technological innovation, or entrepreneurship. The coefficient γ_1 captures the relationship between university basic research and the mediator, while δ_2 captures the relationship between the mediator and regional economic growth after university basic research is controlled for. The indirect effect is measured by the product $\gamma_1\delta_2$, whereas γ_1 represents the direct effect of university basic research. All other variables are defined as in the baseline model.

5.2 Results

5.2.1 Human Capital

Table 9 shows that the total effect of university basic research on regional economic growth is positive but statistically insignificant (coefficient = 0.0171, $p > 0.1$). The coefficient of university basic research in the human-capital equation is −0.1610 and is also insignificant, indicating no detectable positive or negative effect on regional human capital. By contrast, human capital has a positive and statistically significant effect on regional economic growth (coefficient = 0.1007, $p < 0.01$).

Table 9
Mediation test for human capital accumulation

Variable	Total-effect model: GRP per capita	Mediator model: human capital	Full model: GRP per capita
paper	0.0171	-0.1610	0.0333
	(0.0265)	(0.0953)	（0.0247）
edu			0.1007***
			(0.0270)
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	720	720	720
Number of provinces	30	30	30
Within R^2	0.991	0.916	0.992

5.2.2 Technological Innovation

The total effect remains positive but insignificant in Table 10. University basic research has an insignificant coefficient of −0.1157 in the technological-innovation equation, whereas technological innovation significantly promotes regional growth (coefficient = 0.0482, $p < 0.05$). Thus, the evidence does not support technological innovation as a mediator.

5.2.3 Entrepreneurship

Table 11 yields a similar pattern. The coefficient of university basic research in the entrepreneurship equation is −0.0559 and statistically insignificant, while entrepreneurship has a positive effect on regional growth at the 10% significance level (coefficient = 0.0759). The entrepreneurship channel is therefore not supported as a statistically significant mediation mechanism.

Table 10
Mediation test for technological innovation

Variable	Total-effect model: GRP per capita	Mediator model: patents per capita	Full model: GRP per capita
paper	0.0171	-0.1157	0.0227
	(0.0265)	(0.1617)	（0.0283）
perpat			0.0482**
			(0.0212)
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	720	720	720
Number of provinces	30	30	30
Within R^2	0.991	0.952	0.992

Table 11
Mediation test for entrepreneurship

Variable	Total-effect model: GRP per capita	Mediator model: entrepreneurship	Full model: GRP per capita
paper	0.0171	-0.0559	0.0213
	(0.0265)	(0.0465)	（0.0255）
perfirm			0.0759*
			(0.0383)
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	720	720	720
Number of provinces	30	30	30
Within R^2	0.991	0.984	0.991

Table 12 summarizes the mediation test results. The total effect of university basic research on regional economic growth is positive but statistically insignificant. Moreover, university basic research is not significantly associated with human capital, technological innovation, or entrepreneurship, as indicated by the insignificant coefficients for path \(a\). In contrast, all three mediators are positively associated with regional economic growth, although their significance levels vary. Taken together, the results provide no evidence that university basic research contributes to regional economic growth through any of the three proposed channels. Instead, they suggest a potential upstream transmission bottleneck: university knowledge production may not be effectively translated into the regional capabilities necessary for economic application.

Table 12
Summary of the mediation tests

Mediation channel	Total effect Research → GRP per capita	Path a Research → mediator	Path b Mediator → GRP per capita
edu	0.0171 (not significant)	−0.1610 (not significant)	0.1007***
perpat	0.0171 (not significant)	−0.1157 (not significant)	0.0482**
perfirm	0.0171 (not significant)	−0.0559 (not significant)	0.0759*

6. Moderation Analysis

6.1 Moderation Model

Government intervention may influence the extent to which university-generated knowledge is transformed into regional innovation and productive capabilities. On the one hand, government support can facilitate knowledge transfer by providing research funding, improving innovation infrastructure, and strengthening collaboration between universities and industry. On the other hand, excessive intervention may distort resource allocation and weaken market-based incentives. To examine whether government intervention moderates the relationship between university basic research and the proposed mediators, the following model is estimated separately for human capital, technological innovation, and entrepreneurship:

$$M_{i,t}=\alpha_0+\alpha_1 paper_{i,t}+\alpha_2 G_{i,t}+\alpha_3 paper_{it}\times G_{i,t}+\sum_{k=1}^{n}\beta_k\, Controls_{k,i,t}+\mu_i+\lambda_t+\varepsilon_{i,t} \tag{5}$$

where $M_{i,t}$ denotes the mediator, measured alternatively by human capital, technological innovation, or entrepreneurship. The variable $paper_{i,t}$ represents university basic research, while $G_{i,t}$ denotes government intervention. The interaction term $paper_{i,t}$ times $G_{i,t}$ captures the moderating role of government intervention. The model also includes a set of time-varying provincial control variables, province fixed effects μ_i, and year fixed effects λ_t. The idiosyncratic error term is denoted by $\varepsilon_{i,t}$. The coefficient of primary interest is α_3: a positive and statistically significant value indicates that government intervention strengthens the relationship between university basic research and the mediator, whereas a negative and statistically significant value indicates a weakening effect.

6.2 The Moderating Role of Government Intervention

Table 13 reports the moderating effect of government intervention on the relationship between university basic research and human capital accumulation. The coefficient on the interaction between university basic research and government intervention is −0.0204 and statistically significant at the 5% level. Greater government intervention therefore makes the relationship between university basic research and human capital more negative, weakening the potential contribution of basic research to human capital accumulation.

Table 13
The moderating effect of government intervention

Variable	Coefficient	t-statistic	p-value
paper	-0.0443	-0.36	0.720
paper×gov	-0.0204	-2.15	0.040**
gov	0.0895	1.60	0.121
fixed	0.0018	1.89	0.069*
consum	-0.0027	-0.47	0.642
indus	0.0003	0.06	0.953
pop	-0.8356	-1.64	0.111
open	0.1111	1.64	0.111

7. Conclusions and Policy Implications

7.1 Conclusions

Using panel data on university basic research output from 30 Chinese provinces, this study examines the impact of university basic research on regional economic growth. The results show that university basic research has no statistically significant positive effect on regional economic growth. This finding remains robust after replacing the core explanatory variable, the dependent variable, and the estimation model. The mechanism analysis further reveals an upstream bottleneck in the transformation of university basic research into regional economic growth. In particular, greater government intervention weakens the contribution of university basic research to human capital accumulation.

This study contributes to the literature in several ways. First, it evaluates university basic research from both quantitative and qualitative perspectives and finds no significant direct effect on regional economic growth, providing evidence for improving public investment decisions on basic research in developing economies. Second, by examining human capital, technological innovation, and entrepreneurship as potential transmission channels, it identifies the obstacles involved in transforming university research into economic outcomes. Finally, it demonstrates that government intervention is an important institutional factor affecting this transformation, thereby providing empirical support for local governments seeking to improve policy design and public resource allocation.

7.2 Policy Implications

The findings have important policy implications. Local governments should transform their mode of intervention, strengthen institutional coordination, and incorporate university basic research and technology transfer into broader regional development strategies. Greater coordination among science and technology, education, and industrial policies is needed to create a supportive environment for the economic application of university research. Governments should also increase funding for basic research in strategically important and underfunded fields and appropriately adjust education and enrollment policies to improve the alignment between human capital supply and regional industrial demand. In addition, greater investment should be directed toward university–industry collaboration platforms to reduce communication barriers and facilitate knowledge and technology transfer.

This study also has several limitations. Although it identifies the moderating role of government intervention, further research is required to examine the magnitude, boundary conditions, and potential nonlinearities of this effect. Future studies could explore additional transmission channels and provide a more comprehensive account of the process through which university-generated knowledge is transformed into regional economic performance.

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Conflicts of Interest
Authors declare no conflicts of interest.

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