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Does the university knowledge spillover promote common prosperity? Empirical evidence from China

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The 2030 Agenda for Sustainable Development emphasizes the need to foster inclusive economic growth and reduce inequalities across regions. Common prosperity is a national goal in China that emphasizes social equality and shared economic growth, which aligns closely with Sustainable Development Goals. While university knowledge spillover emerged as a critical approach to achieving these objectives, the pathways through which such spillover contributes to common prosperity remain underexplored. The aim of this study is thus to investigate the impact of university knowledge spillover on common prosperity through entrepreneurship. Based on a panel dataset of 30 provinces from 2012 to 2021, we employ the mediation effect model and reveal that university knowledge spillover significantly contributes to common prosperity, with entrepreneurship serving as an intermediary mechanism. Meanwhile, our results show that heterogeneity exists between geographical regions in the impact of university knowledge spillover on common prosperity, and university knowledge spillover has a greater influence on the "prosperity" dimension of common prosperity than on the "commonality" dimension. Our study extends the existing literature on the Knowledge Spillover Theory of Entrepreneurship to the field of inclusive growth, bridging the gap between university knowledge spillover and its socio-economic outcomes. Policymakers are advised to strengthen regional absorptive capacity and enhance the entrepreneurial environment, particularly in underdeveloped regions, to maximize the potential of university knowledge spillovers in fostering common prosperity and advancing sustainable development.

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Introduction

Growth, equality, and sustainable development have always been the common pursuit in the prosperity of mankind, as outlined in the Sustainable Development Goals (SDGs). Consequently, they have been one of the great concerns faced by economists and sociologists. Similar terminologies have been expressed widely in the literature, e.g., The World Bank Group proposed the "shared prosperity" goals, that is, to eliminate extreme poverty by 2030 and increase the income levels of the lowest 40% of the population in every economy(World Bank, 2018). Inclusive growth is another similar concept, which can be defined as growth that benefits the disenfranchised(George et al. 2012). It represents a novel approach to economic growth that strives to enhance living standards and distribute the advantages of increasing prosperity more equitably among diverse social groups (OECD, 2014). Underlying these terminologies is a worldwide appeal for a society that is prosperous and equitable, where economic poverty is ended and the deprived are treated with generosity (Su et al. 2023). Among them, China introduced and advocated the concept of "common prosperity" and exhibited a trajectory of developing economies pursuing growth, equality, and sustainable development.

Common prosperity is an overarching target for inclusive and shared development in multiple aspects including economy, society, politics, culture, and ecological environment across regional areas and social groups (K. Z. Chen et al. 2022). The concept of common prosperity contains two fundamental attributes: "common" and "prosperity" (Y. Zhang et al. 2022b; B. Chen and Zhang, 2023a; Peng et al. 2024). In terms of "prosperity", economic growth and affluence is the cornerstone of common prosperity. Without economic prosperity, society risks devolving into a form of poverty-stricken egalitarianism. Thus, it is essential to "get rich first" and continuously foster high-quality economic development (Dunford, 2022). In terms of "common", it emphasizes the acceleration of income growth for lower-middle-income groups to form an olive-shaped distribution structure (Liu et al. 2024a, p. 121). This aligns closely with SDG 10.1, which calls for significant progress in achieving income growth for the bottom population by 2030. Accordingly, the essence of common prosperity lies in creating a society with equal opportunity and ensuring all people benefit from prosperity, irrespective of age, sex, disability, social strata, or other status (Kakwani et al. 2022; Shi et al. 2025). This is consistent with the targets outlined in SDGs 10.2 and 10.3, which focus on promoting social, economic, and political inclusion and ensuring equal opportunities.

Meanwhile, universities are now entrusted with progressively more significant roles in economic development (Bramwell and Wolfe, 2008; Goldstein and Renault, 2004). The discussion on the role of the university's third mission has been largely construed in the commercial sense of knowledge spillover and technology transfer, in what has often been referred to as an "entrepreneurial university" (Bayuo et al. 2020; Cai and Ahmad, 2023). Nonetheless, universities' role in societal engagement is not merely on the economic dimension but also on the social dimension. Along with the intensifying efforts undertaken by universities to address broader societal needs and changes, a rising number of scholars have called for a renewed understanding of universities' role in the use of knowledge to foster different facets of social development and inclusion (Arocena et al. 2015; Godonoga and Sporn, 2023; J. Li et al. 2024a). However, to date, research on university knowledge spillover has primarily focused on their impact on economic and innovation development, with limited attention paid to their role in social impact, such as reducing inequality and facilitating inclusive growth (Guerrero and Siegel, 2024; Kirschning and Mrożewski, 2024).

The aim of this study is thus to investigate the following questions: *Does the university knowledge spillover promote common prosperity*? And if yes, *then how*? To address the first question, we conduct an empirical study using a panel dataset of 30 Chinese provinces from 2012 to 2021. The environmental and institutional context of China is markedly different compared to the Western world and other emerging economies (C. Chen et al. 2023). Therefore, China's common prosperity campaign offers an intriguing context for analyzing the broader social impact of university knowledge spillover. As one of the world's most populous nations, China's commitment to achieving the SDGs has significant implications and is, thus, frequently scrutinized by the international community (J. Zhang et al. 2022a). Since common prosperity is intricately linked to the objectives outlined in SDG 10, examining the influence of university knowledge spillover on common prosperity contributes to a better understanding of the role of such spillover in global sustainability progress. To address the second question, we introduce the Knowledge Spillover Theory of Entrepreneurship (KSTE), which posits that entrepreneurship functions as the conduit for the transmission of knowledge spillover to the economy and society (Acs et al. 2009). Therefore, we use entrepreneurship as the intermediary to explore the relationship between knowledge spillover and common prosperity.

Our work makes several contributions. First, our study extends the current research on the KSTE to the field of sustainable development and inclusive growth (Eeckhout and Jovanovic, 2002; Osório and Pinto, 2020) by developing a theoretical frame integrating university knowledge spillover with common prosperity and conceptualizing entrepreneurship as an impetus. Second, we enrich the ongoing discussions on expanding the core role of knowledge spillover and entrepreneurial universities from an economic orientation to a more comprehensive orientation in social participation (Cai and Ahmad, 2023; Menter, 2023). We echo the call for studying how knowledge spillover and entrepreneurial universities can contribute to societal goals (Cerver Romero et al. 2021) by providing empirical evidence of the effect of knowledge spillover on common prosperity, thus addressing the appeal for scholars to shed light on the solutions to grand social concerns, via research, with a goal of providing socially inclusive growth (Bruton et al. 2021; George et al. 2016). Third, we contribute to the emerging literature that seeks to assess the social impact of universities. Current research focuses more on social responsibility undertaken by universities than on the measurement of its impact (Godonoga and Sporn, 2023; Larrán Jorge and Andrades Peña, 2017). This study is, to the best of our knowledge, the first to measure the influence of university knowledge spillover on social issues such as inclusive growth.

Literature review and conceptual framework

University knowledge spillover entrepreneurship. The KSTE offers a parsimonious explanation for the emergence of knowledge-based entrepreneurial activities by illustrating how the creation, dissemination, and diffusion of knowledge contribute to the creation of new ventures (Acs et al. 2012b; Iftikhar et al. 2022). The entrepreneurial opportunities, as posited by the KSTE, comprise a collection of novel knowledge and ideas generated endogenously within universities and other research institutions (Audretsch and Keilbach, 2007; Acs et al. 2009). By identifying and leveraging these opportunities, entrepreneurship acts as a catalyst in reducing the knowledge filter, thereby facilitating the conversion of knowledge into products currently absent in the market (Audretsch and Belitski, 2013; Chatmi and Elasri, 2018). As a result, it not only introduces creativity and innovation into

the market but also serves as an agent in fostering economic development (Caiazza et al. 2020). Naturally, certain factors, such as corruption (Batrancea et al. 2023a), negative economic sentiment (L. Batrancea, 2021), and inadequate infrastructure (Batrancea et al. 2023b), may impede the relationship between entrepreneurship and economic development. Nonetheless, the nexus between knowledge spillover and economic growth via entrepreneurship is widely recognized in the literature (Qian and Acs, 2013; Acs et al. 2012b). University plays a critical role in knowledge creation and commercialization, the university-based entrepreneurial ecosystem is a suitable environment for the stakeholders to spill over knowledge through unintentional flows (Secundo et al. 2021). However, limited studies have been there to measure the effect of university knowledge spillover entrepreneurship on regional sustainable development and inclusive growth, especially in developing-world settings (Godonoga and Sporn, 2023; Mahn and Poblete, 2023). Thus, this paper specifically discusses the influence of university knowledge spillover entrepreneurship on China's common prosperity.

Effect of university knowledge spillover on common prosperity. The significant role of universities in transforming knowledge spillover into an impetus for economic prosperity has been long recognized (Astebro and Bazzazian, 2011; Leyden and Link, 2013). Through networks, collaborations, and partnerships, knowledge generated within universities spills over to local industries, enhancing their productivity and ultimately increasing economic growth (Batrancea, 2023; Döring and Schnellenbach, 2006; Ghio et al. 2015). For instance, Lehmann and Menter (2016) found that knowledge spillover via university-industry collaboration has a positive effect on regional competitiveness and wealth. Yang et al. (2024) revealed that government-university-industry networks established around large-scale research infrastructure accelerate the cross-boundary knowledge flow and contribute to regional innovation and economic development. Furthermore, interactions between diverse groups in universities, such as foreign and domestic students or interdisciplinary research teams, can lead to innovative ideas and shared expertise. Scholars indicate that such heterogeneous human capital generates positive spillover effects and accelerates regional innovation and economic development (Wen et al. 2023). In sum, it is conceivable that university knowledge spillover is positively related to the "prosperity" dimension of common prosperity.

As for the "common" dimension, knowledge-sharing is an intellectual foundation for "shared prosperity" (Phillips, 2005). The spillover of knowledge from leading regions to less developed regions fosters economic convergence by allowing imitators to benefit from the diffusion of innovations (C. Chen, 2016; Hou et al. 2022; Rodríguez-Pose and Tselios, 2015). For instance, by examining the education partnership assistance programs in China, Ding and You (2022) suggested that facilitating the diffusion of knowledge, skills, and technology from universities in more prosperous areas to those in underdeveloped regions serves as an important approach to achieving common prosperity. Moreover, the Chinese government emphasizes "blood-creation" anti-poverty policies (Y. Wang et al. 2024). Under its guidance, universities place great importance on collaboration with impoverished regions. These collaborations aim to apply academic knowledge and technological advancements to local industries, thereby spurring economic development and reducing inequality (Y. Wang et al. 2024). Thus, university knowledge spillover also positively impacts the "common" dimension of common prosperity. As a result, the following hypothesis is proposed:

Hypothesis 1. University knowledge spillover has a positive effect in promoting common prosperity.

The mediating effects of entrepreneurship. Knowledge spillover does not necessarily and automatically lead to the anticipated socio-economic development (Audretsch and Keilbach, 2008). Transforming new knowledge generated by universities into viable technologies requires investment, which carries inherent risks due to the uncertainty of outcomes. Entrepreneurs, characterized by their risk-taking personalities, serve as the conduit for translating knowledge into economic products (Audretsch and Keilbach, 2008; Qian, 2018). Through the creation of spin-offs and startups, they commercialize entrepreneurial opportunities arising from university knowledge spillover, which in turn facilitates regional economic growth (Lehmann and Menter, 2016; Patrício and Ferreira, 2024; Wennberg et al. 2011). Extensive literature has underscored this mediating role of entrepreneurship in linking university knowledge spillover to economic prosperity (Acs and Szerb, 2007; Acs et al. 2012a; Audretsch, 2014).

Meanwhile, entrepreneurship has the potential to simultaneously enhance economic growth and spark benefits in society (X. Li et al. 2024b). As indicated by plenty of studies, entrepreneurial activities significantly contribute to inclusive and equitable growth (George et al. 2012; Aparicio et al. 2021; Q. Wang, 2021; Shi et al. 2025). In China, entrepreneurship is regarded as an essential tool for higher education institutions to respond to the national campaign of common prosperity. For instance, the policy "Action Plan for Technological Innovation in Rural Revitalization by Higher Education Institutions" issued by the Ministry of Education of China (CME) supports universities to launch entrepreneurial projects aimed at serving rural and impoverished areas. Five years after the policy's implementation, data from the CME reveals that over 170,000 faculty and students have been sent to these regions. Their primary activities include knowledge transfer and entrepreneurial initiatives designed to enhance local industries and boost economic growth. In sum, driven by policies related to common prosperity, universities are dedicated to translating economic knowledge into inclusive entrepreneurial activities aimed at promoting equitable economic growth (Yao et al. 2018). As a result, we posit:

Hypothesis 2. University knowledge spillover promotes common prosperity by stimulating entrepreneurship.

Methodology
Data and sample. As discussed above, China's common prosperity campaign offers an intriguing context for analyzing the broader social impact of university knowledge spillover. The aim of this study is thus to investigate the role of university knowledge spillover on China's common prosperity. Specifically, among China's 34 provinces, Taiwan, Hong Kong, and Macau exhibit distinct political and economic systems compared to the mainland. Since the policy of common prosperity is mainly implemented on the mainland, these regions are excluded from the sample. Additionally, Tibet is excluded due to a significant lack of relevant data. Consequently, our samples are drawn from 30 provinces in China between 2012 and 2021. The data on the indicators of common prosperity, entrepreneurship, and the control variables involved in this paper are mainly from the China Statistical Yearbook, university knowledge spillover data are from the Compilation of Scientific and Technological Statistical Data of Universities.

Measures. *Dependent variable*. The dependent variable is common prosperity, which involves both "common" and "prosperity"

Table 1 Index system of common prosperity in China.

Dimension	Secondary indicators	Three-level indicators	Effects
Prosperity	Economic growth	Residents' disposable income per capita	Positive
		GDP per capita	Positive
	Resident Life	Engel Coefficient	Negative
		Urban registered unemployment rate	Negative
		Per capita consumption expenditure	Positive
Commonality	Inclusive growth	Share of labor remuneration in the primary distribution	Positive
	Urban–rural gap	The ratio of Engel Coefficient of urban residents to that of rural residents	Negative
		Theil index of Urban-Rural Income Gap	Negative
		c index of urban-rural consumption gap	Negative
	Medical treatment	Beds in medical institutions per thousand population	Positive
	Education development	Expenditure on education	Positive
		Gini coefficient of education	Negative
	Public culture	Public library holdings per capita	Negative

dimensions(Y. Zhang et al. 2022b; B. Chen and Zhang, 2023a). It is denoted as *CP*. Referring to relevant literature(B. Chen and Zhang, 2023a; L. Chen and Zhang, 2023b; Xie et al. 2022), this paper constructs an index system for the dependent variable from two categories of "commonality" and "prosperity" considering the availability of inter-provincial data. "Commonality" mainly focuses on equality and inclusive growth, reflecting the fair distribution process of development opportunities such as income, wealth, and basic public services. "Prosperity" focuses on the overall level of social development and economic growth (Kakwani et al. 2022; Y. Wang et al. 2022). In conclusion, our index system of common prosperity comprises 2 categories and 13 indicators, as shown in Table 1.

Referring to previous research (Peng et al. 2024; Shi et al. 2025), we introduce the entropy weight method to compute the evaluation results of the level of common prosperity. The method is widely employed in decision-making processes and serves as an objective weighting approach aiming to mitigate the biased influence of subjective human factors on index weight setting (Ma et al. 2022). The specific calculation process is as follows:

First, we standardized the original data to eliminate the influence of magnitude, as follows:

Positive indicators:

$$x_{ijt}' = \frac{x_{ijt} - \min(x_{ijt})}{\max(x_{ijt}) - \min(x_{ijt})} \tag{1}$$

Negative indicators:

$$x_{ijt}' = \frac{\max(x_{ijt}) - x_{ijt}}{\max(x_{ijt}) - \min(x_{ijt})} \tag{2}$$

Where x_{ijt} represents the original value of index j of province i in year t.

Second, we calculate the weight of each index as follows:

$$p_{ijt} = \frac{x_{ijt}'}{\sum_{i=1}^{m}\sum_{t=1}^{T} x_{ijt}'}, \quad e_j = -\frac{1}{\ln(m \times T)}\sum_{i=1}^{m}\sum_{t=1}^{T} p_{ijt}\ln p_{ijt} \tag{3}$$

p_{ijt} indicates the weight of province i of index j in year t. e_j represents the information entropy of the index.

Third, the weight of the indicator is calculated as follows:

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^{n} e_j} \tag{4}$$

w_j represents the entropy value of each index, we enlarged the value by 100 times.

Independent variable. The independent variable is university knowledge spillover. The KSTE indicates that entrepreneurs commercialize knowledge spilled over from the R&D activities of existing organizations (Kirschning and Mrożewski, 2023). Essentially, human capital plays a fundamental role in knowledge creation and R&D activity (Qian and Acs, 2013). R&D capital is, to a great extent, embodied in R&D employees (Acs et al. 2009; Acs and Sanders, 2013). Therefore, referring to previous literature (Koch and Simmler, 2020), this paper uses the R&D employees (1000 persons) in universities as a proxy variable for knowledge spillover(*rdemp*).

Mediating variable. As posited by the KSTE, entrepreneurship functions as the conduit for the transmission of knowledge spillover to the economy and society (Acs et al. 2009; Acs and Sanders, 2013). Aligning with this theoretical perspective, we choose entrepreneurship as the mediating variable and define it as the formal creation of private businesses (Acs et al. 2008). Accordingly, we follow previous studies in using the number of registered private enterprises (*entact*) as a proxy for entrepreneurial activities (Lan et al. 2018) and normalize these counts by the total size of the population in the province (per 10,000 persons), as in Azoulay et al. (2022). Given the significant role of private enterprises in promoting common prosperity (Ren, 2023), this metric provides a standardized measure that helps capture the mechanism through which knowledge spillover contributes to common prosperity.

Control variables. (1) Foreign direct investment (*foriv*), measured by the gross foreign investment to GDP. Previous research indicates that foreign direct investment has a positive effect in reducing the income gap (Deng et al. 2025) and is, therefore, a significant driver in achieving common prosperity (Liu et al. 2023). (2) Human capital(*humc*), measured as the population with tertiary education(1,000,000 persons). The human capital externalities arising from knowledge exchange are a significant factor that influences regional prosperity (Liu et al. 2024b). (3) Openness (*open*), measured by the total foreign trade imports and exports as a percentage of GDP. The control of economic openness is essential due to its potential confounding effects on common prosperity. While empirical research by Deng et al. (2025) reveals that economic openness is positively related to the level of common prosperity, other scholars suggest a negative relationship between openness and common prosperity (Peng et al. 2024). (4) Industrial structure (*indu*), measured by the added value of the tertiary industry as a percentage of GDP. As suggested by scholars, industrial structure is a factor that influences regional economic development and income inequality (Liu et al. 2023).

Table 2 Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.	Jarque-Bera
CP	300	40.952	6.962	29.244	69.812	1.104	4.531	90.3***
rdemp	300	14.617	10.837	0.461	69.452	1.139	4.915	110.7***
entact	240	164.777	134.279	37.309	830.975	2.42	9.848	703.2***
open	300	0.04	0.043	0.001	0.228	2.114	7.455	471.4***
indu	300	0.484	0.095	0.309	0.839	1.339	5.894	194.3***
forinv	300	6.858	1.422	3.377	10.72	0.013	2.785	0.5854
humc	300	0.736	2.553	0	19.783	4.232	22.918	5855***

***$p < 0.01$

Table 3 Correlation matrix and VIF of the variables.

	CP	rdemp	entact	open	indu	forinv	humc	VIF
CP	1							
rdemp	0.696***	1						2.79
entact	0.883***	0.682***	1					4.53
open	0.553***	0.615***	0.687***	1				2.29
indu	0.753***	0.580***	0.820***	0.601***	1			3.31
forinv	0.688***	0.741***	0.663***	0.611***	0.519***	1		3.00
humc	0.252***	0.202***	0.0340	0.0190	0.182***	0.255***	1	1.05

***$p < 0.01$

Table 2 provides descriptive statistics for each of the selected variables after removing missing values. As for skewness values, all variables showed positive skewness, indicating a right-skewed distribution (Batrancea, 2022; Batrancea et al. 2022b). Concerning kurtosis, all variables except *foriv* displayed leptokurtic distributions, given that their kurtosis values were above the threshold of 3 (L. M. Batrancea et al. 2022a). Moreover, the Jarque–Bera test results showed that all variables except *foriv* were significant at the 1% level, indicating a rejection of the null hypothesis of normal distribution (Batrancea et al. 2023c).

Table 3 presents the correlation matrix and VIF of the variables. Since all correlation values remained below the standard threshold of 0.9 and VIF values did not exceed 10, we concluded that there was no risk of multicollinearity (L. M. Batrancea, 2022; L. M. Batrancea et al. 2022b).

Estimation model. To empirically verify the mechanism of university knowledge spillover promoting common prosperity, we construct the following models referring to previous research (Baron and Kenny, 1986; MacKinnon et al. 2002; Pan et al. 2022; Shi et al. 2025):

$$comp_{it} = \alpha_0 + \alpha_1 know_{it} + \alpha_2 control_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \quad (5)$$

$$entrep_{it} = \beta_0 + \beta_1 know_{it} + \beta_2 control_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \quad (6)$$

$$comp_{it} = \gamma_0 + \gamma_1 know_{it} + \gamma_2 entrep_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \quad (7)$$

Equation (5) is the benchmark regression model, where i, t represent provinces and years, *comp* represents common prosperity, *know* represents university knowledge spillover, *control* represents the control variables, and ε_{it} is the random disturbance terms. In Eq. (6), *entrep* is the intermediary variable, which represents entrepreneurship activity. The procedure for the mediation effect test is as follows: First, Eq. (5) is estimated to test the total influence of the university knowledge spillover in promoting common prosperity; Second, we estimate Eq. (6) to test the connection between university knowledge spillover and

Table 4 Benchmark regression results.

	(1)	(2)
	CP	CP
rdemp	0.258***	0.211***
	(0.059)	(0.053)
_cons	31.53***	36.09***
	(0.813)	(2.507)
Control variables	NO	YES
Province fixed	YES	YES
Year fixed	YES	YES
N	300	300
R^2	0.919	0.923
adj. R^2	0.916	0.919

Robust standard errors in parentheses, ***$p < 0.01$

the mediator variable. Third, test the impact of university knowledge spillover on common prosperity after controlling the mediator variable in Eq. (7). If the coefficients α_1, β_1, and γ_1 are all statistically significant and γ_1 is less than the value of α_1, it indicates the presence of a mediation effect.

To evaluate the model specification and validity, we conduct the F-test, the Hausman test, and the Heteroskedasticity test, as shown in Appendix 1. The results of the F-test and Hausman test reveal that the fixed effects model should indeed be used (L. Batrancea, Rathnaswamy, and Batrancea, 2022). The results of the heteroskedasticity test rejected the null hypothesis of homoscedasticity. Therefore, robust standard errors were estimated in all regressions to address heteroskedasticity (Wooldridge, 2016, pp. 244–246).

Empirical results

Benchmark regression. The benchmark regression results are displayed in Table 4. Model (1) shows the direct impact of the university knowledge spillover without introducing additional

control variables, the result indicates a highly significant positive coefficient at the 1% level. Model (2) is the baseline model, encompassing all control variables. The findings reveal a coefficient of 0.211 for university knowledge spillover, which passes the statistical test at the 1% significance level. This suggests that the promotion of common prosperity is indeed facilitated by university knowledge spillover.

There is a strand of literature that seeks to identify the externalities of knowledge spillover. While some studies emphasized the role of knowledge spillover in economic development (Qian and Acs, 2013; Acs et al. 2012b), others reported the existence of a knowledge paradox, wherein newly generated knowledge does not always lead to endogenous growth (Audretsch and Keilbach, 2008). A plausible explanation for this paradox lies in differences in institutional contexts. Knowledge spillover research primarily explains the growth process in the context of developed economies (Iftikhar et al. 2020), where well-established market environments support the translation of knowledge into economic outputs. By contrast, in countries with weaker market structures, knowledge spillovers may encounter much more barriers. For instance, the research of Mahn and Poblete (2023) found that knowledge spillover exhibits low effectiveness in the context of a developing economy. By providing empirical evidence of the positive externalities of knowledge spillover in a developing setting, the results of our benchmark regression can potentially help to reconcile previous, partially contradictory findings.

Robustness test. To ensure the robustness of our findings, several additional analyses were conducted, and the corresponding results are presented in Table 5.

First, replace the independent variable. We conducted several additional independent variables to replace the independent variable used in benchmark regression. In Model (1) of Table 5, we used the number of full-time R&D employees(1,000 persons) as the proxy variable of university knowledge spillover(*rdftemp*). The positive results echo studies that identify the positive externalities of knowledge spillovers among R&D employees (N. Xu et al. 2024; Zacchia, 2020). Since R&D investment is another proxy variable of university knowledge spillover widely used in literature(X. Xu et al. 2019; Audretsch and Belitski, 2022), we use R&D investment(*rdinv*) to replace the R&D employees, in which R&D investment is the sum of investment in R&D basic research (100,000,000 RMB). The results in Model (2) exhibit a significant

positive coefficient. This validates scholars' perspectives that the spillover generated by R&D investment possesses social value in boosting sustainable development (Sarpong et al. 2023).

Second, remove the special samples. Unlike regular provinces, Beijing, Shanghai, Tianjin, and Chongqing are provincial-level municipalities subject to direct governance by the central government, and there are significant variations between them and other local governments in terms of economic development and social conditions. Thus, we discard the special samples of municipalities and use only samples of ordinary provinces for robustness testing. In Model (3), the coefficient of *rdemp* is positively significant at the 1% level, indicating that the baseline findings are trustworthy. This is consistent with the study by Shi et al. (2025), which also mitigated the potential impact of special samples on common prosperity by excluding municipalities.

Third, replace the dependent variable by using an alternative method. In addition to the entropy method, principal component analysis (PCA) is another commonly used method for feature extraction. PCA converts a group of potentially correlated variables into a group of uncorrelated linear variables, thereby diminishing the dimensionality of a dataset. This process aims to preserve the maximum possible variance of the original data. The results of the regression are presented in Model (4) of Table 5, where *CPpca* denotes the new dependent variable calculated by PCA and is enlarged by 100 times. The coefficient of *CPpca* is positively significant ($\beta=0.299$, $p < 0.01$). This robustness test aligns with the study of Ma et al. (2022) and Y. Liu et al. (2023), which adopted the PCA method as an alternative approach for assessing common prosperity.

Regional heterogeneity analysis. The effect of knowledge spillover on socio-economic development is contingent upon a region's absorptive capacity (Kirschning and Mrożewski, 2023). Considering the great disparities among different regions in China in terms of infrastructure, industrial development, and innovation systems, the absorptive capacity for university knowledge spillover exhibits heterogeneity across regions (Fan and Xu, 2024; Wen et al. 2023). Acknowledging these disparities ensures a more nuanced understanding of how knowledge spillovers contribute to common prosperity across diverse regional contexts. Therefore, we categorize the sample provinces into 3 categories to analyze the potential regional heterogeneity (Cheng et al. 2016): eastern, central, and western. The regression results of the three regions are reported in Table 6, where models (1) - (3) correspond to the eastern, central, and western regions, respectively. The heterogeneity analysis suggests that the coefficients for the eastern region are significant, whereas those in the central and western regions are not. On the one hand, the

Table 5 Robustness results.

	(1)	(2)	(3)	(4)
	CP	*CP*	*CP*	*CPpca*
rdftemp	0.164***			
	(0.037)			
rdinv		0.170***		
		(0.038)		
rdemp			0.221***	0.299***
			(0.078)	(0.078)
_cons	38.15***	35.28***	34.75***	30.08***
	(2.696)	(2.481)	(2.754)	(4.372)
Control variables	YES	YES	YES	YES
Province fixed	YES	YES	YES	YES
Year fixed	YES	YES	YES	YES
N	300	300	260	300
R^2	0.918	0.931	0.917	0.916
adj. R^2	0.914	0.928	0.912	0.912

Robust standard errors in parentheses, ***$p < 0.01$

Table 6 Regional heterogeneity analysis.

	(1)	(2)	(3)
	CP	*CP*	*CP*
rdemp	0.196***	0.025	0.083
	(0.046)	(0.114)	(0.095)
_cons	49.64***	20.78***	30.46***
	(6.256)	(4.418)	(2.892)
Control variables	YES	YES	YES
Province fixed	YES	YES	YES
Year fixed	YES	YES	YES
N	110	90	100
R^2	0.938	0.940	0.939
adj. R^2	0.929	0.929	0.929

Robust standard errors in parentheses, ***$p < 0.01$

Table 7 Mediation effect test.			
	(1)	(2)	(3)
	CP	*entact*	*CP*
rdemp	0.211***	3.508***	0.090**
	(0.053)	(1.131)	(0.040)
entact			0.010*
			(0.006)
_cons	36.09***	242.8**	37.97***
	(2.507)	(100.4)	(4.926)
Control variables	YES	YES	YES
Province fixed	YES	YES	YES
Year fixed	YES	YES	YES
N	300	240	240
R^2	0.923	0.916	0.934
adj. R^2	0.919	0.911	0.930

Robust standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table 8 Sobel-Goodman tests.				
	Coef	Std Err	Z	P > |Z|
Sobel	0.035	0.014	2.466	0.014
Goodman-1 (Aroian)	0.035	0.015	2.435	0.015
Goodman-2	0.035	0.014	2.498	0.013

Table 9 Estimates of the instrumental variables approach.		
	(1)	(2)
	First stage	Second stage
	rdemp	*CP*
staff	17.267***	
	(3.11)	
rdemp		0.315**
		(0.131)
Control variables	YES	YES
Province fixed	YES	YES
Year fixed	YES	YES
N	300	300
First-stage F statistic	30.92	
rk LM statistic	12.76***	

Robust standard errors in parentheses, **$p < 0.05$, ***$p < 0.01$

Table 10 Regressions results of two sub-dimensions.		
	(1)	(2)
	CPP	*CPC*
rdemp	0.329***	0.135**
	(0.104)	(0.055)
_cons	32.23***	38.55***
	(4.690)	(2.508)
Control variables	YES	YES
Province fixed	YES	YES
Year fixed	YES	YES
N	300	300
R^2	0.901	0.837
adj. R^2	0.896	0.829

Robust standard errors in parentheses, **$p < 0.05$, ***$p < 0.01$

majority of China's elite research-oriented universities are situated in the eastern region. These universities have generated a substantial amount of knowledge, leading to a greater spillover of knowledge into the Eastern region. On the other hand, the eastern region has a more favorable entrepreneurial environment, characterized by better infrastructure, greater government support, and a more stable financial system, making it easier for knowledge spillover to be absorbed by entrepreneurship, thereby promoting regional common prosperity.

Analysis of mechanisms. The estimated outcomes of the mediation effect, wherein entrepreneurship plays a role in the impact of university knowledge spillover on common prosperity, are presented in Table 7. Model (1) is the baseline regression. Model (2) indicates that the university knowledge spillover has a significantly positive impact on regional entrepreneurship activities. Model (3) is introduced to test the indirect effect if the magnitude of the coefficient for university knowledge spillover is reduced when the mediator variable entrepreneurship is included. The coefficient of *rdemp* and *entact* are significantly positive, and the magnitude of the coefficient for *rdemp* in Model (3) is lower than that in Model (1). The results confirm the existence of the mediation effect.

Meanwhile, we use the Sobel-Goodman tests to verify the indirect effect. The results are shown in Table 8. The mediation effect can be considered valid when the Sobel test Z value is significant. The results of the Sobel-Goodman tests support the presence of a mediation effect.

Dealing with endogeneity: an instrumental variable approach. We adopt an instrumental variable approach to deal with the potential endogeneity problem between university knowledge spillover and common prosperity. Specifically, we choose the number of administrative staff (*staff*) as an instrumental variable. On the one hand, administrative staff provide necessary support and services to facilitate knowledge transfer and entrepreneurial activities among students and teachers in China (Mei and

Symaco, 2022). Thus, administrative staff is positively related to university knowledge spillover. On the other hand, the number of university administrative staff depends mainly on the educational administration and internal decisions of the university, which is relatively exogenous to regional common prosperity. Table 9 shows the regression results using the two-stage-least-squares (2SLS) method. The F value of the first stage is more than 10, which indicates that the number of administrative staff is not a "weak instrumental variable". The rk LM test rejects the null hypothesis of the "under-identification test". The empirical results in Model (1) show that the instrumental variable can significantly enhance knowledge spillover. The results in Model (2) show that knowledge spillover still significantly promotes common prosperity after introducing the instrumental variable.

Discussions
This paper conducts an in-depth investigation into the influence of university knowledge spillover on promoting common prosperity. As mentioned above, common prosperity includes both "commonality" and "prosperity" dimensions. To accurately and comprehensively evaluate the effects of university knowledge spillover on common prosperity, we further assess the possible impact of university knowledge spillover on different sub-dimensions of common prosperity. The results are displayed in Table 10, where *cpp* denotes the "prosperity" dimension of common prosperity, and *cpc* denotes the "commonality" dimension of common prosperity. It is noteworthy that the coefficient value of *cpp* is more than two times that of *cpc*, demonstrating that university knowledge spillover has a greater

impact on the "prosperity" dimension than on the "commonality" dimension.

Several key insights can be drawn from the above analysis. First, the asymmetrical influence of university knowledge spillover on different sub-dimensions of common prosperity underscores the inherent challenges in translating economic knowledge into equitable social outcomes (Fang et al. 2008). Technological knowledge tends to concentrate among those who already possess resources, leaving behind marginalized groups. As highlighted in the relevant literature (Ongo et al. 2024; Xiao et al. 2024), technological innovation may exacerbate economic inequality if not managed inclusively, thereby complicating their relationship with inclusive growth (Osório and Pinto, 2020). Therefore, scholars advocate for an expansion of the university's economic-oriented role to include broader societal engagement (Cai and Ahmad, 2023; Carl and Menter, 2021). However, limited research has been conducted on the role of universities, particularly in areas such as knowledge and technology transfer, in fostering inclusive growth (Menter, 2023). Drawing on the case of common prosperity in China, we provide evidence that university knowledge spillovers contribute not only to economic development (prosperity) but also to social equity and inclusion (common), albeit the impact on the latter is smaller than the former. In this respect, we contribute to the ongoing discussions on the societal role of universities (Cai and Ahmad, 2023; Menter, 2023) and become particularly relevant in light of the scant qualitative works in measuring the social impact of higher education institutions (Godonoga and Sporn, 2023; Klofsten et al. 2019; Roncancio-Marin et al. 2022).

Second, China is emerging as "a competitor in the pursuit of technological leadership" (Marini, 2024), particularly in sectors such as artificial intelligence (AI), autonomous vehicles, and robotics. These sectors represent significant opportunities for leveraging university knowledge spillover to foster prosperity. For instance, AI research in Chinese universities can be transferred to the private sector, resulting in the development of the local AI industry (Khanal et al. 2025). However, the concentration of technological innovation in eastern urban areas, such as Beijing, Tianjin, and Shanghai, raises concerns about regional imbalances (A. Xu et al. 2023). As revealed in our regional heterogeneity analysis, the influence of university knowledge spillover is significant in eastern areas but insignificant in central, and western areas. Nevertheless, recent types of knowledge spillover, including open innovation platforms and digital dissemination, have shown great potential for promoting the "common" dimension of common prosperity. For instance, digital technology has enabled university knowledge spillover to transcend physical boundaries, thereby reaching rural and underserved areas (Amjad et al. 2024; Popescu et al. 2020).

Third, our research confirms the significant role of university knowledge spillover entrepreneurship in socio-economic development. However, as highlighted in our regional heterogeneity analysis, the influence of university knowledge spillover depends on a region's absorptive capacity and entrepreneurial environment, which is consistent with previous studies (Arcos-Guanga et al. 2024; Kirschning and Mrożewski, 2023). Therefore, it is essential to enhance regional absorptive capacity and entrepreneurial environment conducive to knowledge spillover entrepreneurship. This includes implementing supportive policy frameworks, establishing resilient financial systems, and strengthening R&D infrastructure (Arcos-Guanga et al. 2024; Weng et al. 2024). However, systemic barriers to knowledge spillovers persist, such as rigid academic reward systems that prioritize publications over commercialization and insufficient integration of entrepreneurial training into higher education curricula (Zhu and Yang, 2024), which hinder universities' contributions to common prosperity.

Fourth, this study provides insights into how university knowledge spillover contributes to achieving SDG 10. Specifically, guided by policies related to common prosperity, universities actively engage in entrepreneurial activities in impoverished and rural areas, transforming economic knowledge into a driving force for local economic development (Lv et al. 2024), thereby helping low- and middle-income groups increase their income and contributing to SDG 10.1. In addressing SDGs 10.2 and 10.3, university knowledge spillovers help reduce structural barriers to entrepreneurship by democratizing access to innovation resources and enabling marginalized groups to access advanced knowledge and technology (Audretsch et al. 2024). However, knowledge spillover from universities has a broad impact that can align with and promote multiple SDGs beyond just SDG 10, such as SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure). Thus, it is necessary to delve deeper into the linkages between the university knowledge spillover and SDGs.

Conclusions

This paper endeavors to examine how knowledge spillover affects common prosperity through entrepreneurship. Based on a panel dataset covering 30 Chinese provinces from 2012 to 2021, we find that: First, in general, university knowledge spillover has a positive effect in promoting common prosperity. Second, the results from the heterogeneity analysis indicate that university knowledge spillover in the eastern region has a positive and significant impact on common prosperity. Third, entrepreneurship plays a mediating role in the process of university knowledge spillover promoting common prosperity. Fourth, the impact of university knowledge spillover is more pronounced on the "prosperity" dimension of common prosperity than on the "commonality" dimension. Our findings underscore the importance of sustainable and inclusive growth. By fostering knowledge-based entrepreneurship, regions can not only improve economic outcomes but also promote environmentally sustainable innovations that align with the global Sustainable Development Agenda.

While this study provides valuable insights into the role of university knowledge spillovers in promoting common prosperity, several limitations must be acknowledged. First, the focus on the Chinese context in our research may limit the generalizability of the findings to worldwide trends. Future research should take into account the different inclusive growth patterns among different economies. Second, while we focus on entrepreneurship as a typical conduit for knowledge spillover, future studies should include other influencing factors, such as regional innovation or socio-cultural variables. Third, as global trends such as digital transformation and the green economy reshape the entrepreneurial landscape, future research should explore how universities can further enhance knowledge spillovers in these emerging areas. Investigating how technological innovation and green entrepreneurship contribute to common prosperity in the context of university knowledge spillover could provide valuable insights for policymakers and academic researchers alike.

Data availability

The datasets generated during and/or analysed during the current study are available in the article supplementary files.

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Author contributions

D.M. designed and performed the study. J.C. analysed and interpreted the data. D.M. wrote the initial draft of the paper. J.C. critically revised the manuscript. All authors have contributed to, read, and approved the final version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

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Additional information

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