INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 14, Issue 3, (2025) E-ISSN: 2226-3624

The Impact of Different Industry-Education Integration Models on Corporate Financial Performance

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To Link this Article: http://dx.doi.org/10.6007/IJAREMS/v14-i3/25906 DOI:10.6007/IJAREMS/v14-i3/25906

Published Online: 19 July 2025

Abstract

Industry-education integration is vital for fostering global economic advancement and corporate progress. This study examines the effect of several industry-education integration models on the financial performance, utilising cross-sectional data from 166 publicly listed Chinese companies in 2022. The findings indicate that the transfer of human resources markedly enhances all financial metrics. Scientific publications, intellectual property, informal idea sources, and research services often positively influence many financial metrics. The findings regarding the influence of research partnerships on financial performance are contradictory. The findings emphasize the disparities in the efficacy of various industry-education integration models, highlighting the need for focused collaborative strategies to enhance firm performance and provide practical insights for firms seeking to develop industry-education integration strategies.

Keywords: Industry-Education Integration, University-Industry Collaboration, Corporate Financial Performance, Cooperation Model

Introduction

Global technological improvements, especially within the framework of the Fourth Industrial Revolution, necessitate that educational institutions modify their techniques to more effectively correspond with industrial requirements. This alignment fosters the development of inventive talent, essential for sustaining economic competitiveness and addressing the requirements of contemporary economies. Research indicates that nations prioritising the alignment of educational curricula with industry standards have notable enhancements in educational outcomes, thereby boosting overall economic performance (Xu et al., 2020; Gao & Zhang, 2020; Lv et al., 2022). Integrating practical experience via internships and cooperative education cultivates an atmosphere in which students may use theoretical knowledge in real-world circumstances, enhancing employability and entrepreneurship (Gao

& Zhang, 2020; Xinming, 2023; Hu et al., 2021). The comprehensive educational ecosystem is essential in equipping students for a dynamic and constantly changing work market. By integrating advanced technology competencies into their curricula, institutions foster a workforce capable of adapting to and excelling in swiftly evolving industrial environments (Koul & Nayar, 2020; Lv et al., 2022). Programs that integrate creativity and entrepreneurship with technical education enable students to create and devise unique solutions to intricate challenges, which is especially crucial in sectors marked by swift technological progress (Lv et al., 2022; Qu, 2021). Initiatives that integrate entrepreneurship education with conventional curricula have demonstrated considerable promise in augmenting students' innovative abilities, hence contributing to economic growth (Lv et al., 2022; Cheng et al., 2024; Qu, 2021). The integration of industry and education extends beyond immediate educational outcomes, fulfilling a broader economic role by fostering industrial innovation and improving overall productivity. Countries aiming for enhanced economic performance demonstrate a synergistic relationship between educational institutions and industries, which serves as a comprehensive strategy for sustainable development and societal advancement (Li & Wan, 2023; Wang, 2023; Zhang & Xiu-bo, 2021; Zhang et al., 2024). Targeted educational practices that address skills gaps in various sectors can enable nations to cultivate a workforce equipped to meet future economic demands and promote innovation across multiple domains (Liu, 2024; Wang, 2022).

The interaction among scientific and technological advancements, informatisation, and educational integration is transforming the global economic landscape. Countries that prioritise innovation as a fundamental driver of economic growth and strategically integrate industry with education are more effectively equipped to address the complexities of contemporary economies (YANG, 2023; Wang, 2023; Jia, 2023). The ongoing development of educational practices, in accordance with industry requirements, improves educational quality and acts as a driver for economic growth (Wang, 2023; Lin et al., 2024; Wei, 2024). Moving forward, it is essential to foster collaboration between educational institutions and industries to nurture the next generation of innovative leaders who can address future challenges.

In numerous developed countries, the integration of industry and education has yielded significant outcomes. Germany's dual training program effectively develops highly talented individuals by integrating theoretical instruction with practical experience in enterprises (Khurniawan et al., 2021). In Japan, educational curriculum is strongly aligned with industrial requirements through school-enterprise collaboration, technical colleges, and orientation training programs (Zhang et al., 2024). The apprenticeship and vocational training systems in Switzerland (Bakar & Fei, 2024) and Finland (Zhang et al., 2022) have effectively achieved the seamless integration of theory and practice, thereby offering robust talent support for industrial advancement.

The integration of industry and education in China encounters numerous challenges that impede effective collaboration between these sectors. A notable concern is the evident discrepancy between the educational curriculum and the real requirements of industries. This discord may result in a workforce inadequately equipped to meet contemporary industry demands, especially in fast-changing sectors like software development, which necessitates ongoing innovation and adaptability among its personnel (Yao et al., 2020). This disconnect

may lead to diminished competitiveness for Chinese enterprises in a global market characterised by technological agility and innovation (Jiang et al., 2022).

Furthermore, the collaborative channels between educational institutions and businesses in China are frequently deemed inadequate. The administrative frameworks overseeing these agreements sometimes display inflexible procedures that fail to adapt swiftly to industry requirements. This inflexibility can hinder the development of beneficial collaborations that may improve educational programs to align more closely with the skills and information desired by employers (Chen et al., 2024). Although several efforts seek to promote school-enterprise relationships, they frequently lack the requisite support and resources for effective knowledge sharing, hence widening the disparity between educational and industrial requirements (Ding, 2024). Moreover, inadequate methods for technology transfer and information dissemination continue to exist. Inadequate infrastructure and funding, particularly in vocational education, impede the establishment of robust connections between academic institutions and companies. Less economically developed regions in China generally possess fewer educational resources and industrial investments than more affluent places, resulting in a mismatch that hinders the integration of industry and education (Zhou & Peng, 2023). The resulting differences in regional development are evident in differing levels of educational quality and access to innovative technologies, which greatly impact the overall landscape of technology transfer nationwide (Yang & Xu, 2021).

In fact, the difficulties faced by China's industry-education integration (hereafter referred to as IEI) include: imperfect school-enterprise cooperation mechanism, rigid administrative system, insufficient information technology and knowledge sharing mechanism, uneven regional development and insufficient investment in vocational education infrastructure. These institutional and structural problems often weaken the motivation and effect of cooperation between the two sides, making enterprises more cautious in actual participation. Part of the reason may indeed involve enterprises' lack of active participation and concerns that IEI may not be in line with their own interests. A major obstacle to IEI is the reluctance of companies to engage in collaborative initiatives. This prudent strategy is due to apprehensions about the congruence of industrial interests with educational goals (Ankrah & AL-Tabbaa, 2015).

China's university-industry cooperation (hereafter referred to as UIC) and integration of industry and education have indeed seen a phenomenon where schools are enthusiastic but enterprises are not enthusiastic, resulting in the fact that the effect of integration of industry and education has not yet been fully exerted in China. In the various forms of integration of industry and education in the past, more of them were based on the school's standpoint to "raise requirements" on the enterprise industry, and the educational color in the integration of industry and education was stronger. With the continuous deepening of the integration of industry and education and the in-depth promotion of vocational education reform, the foothold of the integration of industry and education will gradually shift to focusing on the interests of enterprises and "giving benefits" to enterprises. In the past, the integration of industry and education may have ignored or even damaged the economic interests of enterprises. Now, the country is paying more and more attention to the integration of industry and education. With the advancement of the policy of integration of industry and education, the continuous improvement and perfection of the combined incentive policy of

"finance + finance + land + credit", the functional significance of the integration of industry and education in promoting the development of enterprise industries may gradually emerge. IEI is expected to create economic value for firms via technical change by enhancing their absorptive capacity and innovative performance (Kobarget al., 2018), as shown by the development of new and/or improved corporate products and practices that can help firms improve their financial performance and survive in a global and competitive market. The shift towards open business models in industry and universities' third mission in academia has increased collaboration between universities and enterprises globally. Collaboration should improve and develop firm products and methods, enhancing financial success. There is little research on how this phenomenon affects corporate performance, especially financially, which is one of the key incentives for firms to contact universities. Although there is a lot of research on UIC and its implications on R&D and innovation processes at organizations, little is known about its consequences on corporate financial performance (Manrique & Grifell-Tatjé, 2020). So, from the perspective of corporate interests, does participating in IEI harm its financial interests or improve financial benefits? This article aims to answer this question through empirical analysis to resolve the confusion of whether companies' participation in IEI harms their financial interests.

As global economic integration and technological innovation progress rapidly, countries around the world are seeing substantial changes in industrial frameworks and economic rivalry (Nguea et al., 2022) . At the macro level, scientific and technological advancements, along with informatisation, have facilitated the high-quality development of the global economy. Countries prioritise scientific and technological innovation as their primary competitive advantage, with IEI emerging as a crucial vehicle for facilitating knowledge transfer and innovation, progressively becoming the focal point of policy and practice. From a micro viewpoint, various IEI models furnish firms with advanced technology, talent development, and research and development support, directly influencing corporate financial performance. Certain models can markedly enhance business earnings and market competitiveness, whilst others exhibit restricted or postponed impacts. Consequently, examining the effects of various IEI models on corporate financial performance holds substantial theoretical importance and practical utility, aiding companies in developing more precise collaboration strategies and offering a scientific foundation for the enhancement of government policies.

Development of Research Hypotheses

According to the different needs and motivations for university-industry collaboration, the modes and contents of university-industry collaboration are also different. The most common university-industry collaboration models described in the literature mainly include hiring graduates, jointly supervising degrees, company employees receiving training from the university, company employees giving lectures at the university, companies or universities organizing or sponsoring conferences or other activities, informal Meetings, conversations or communications, corporate use of university facilities, equipment, laboratories, collaborative research or joint research projects, contract research or technology-related consulting, corporate licensing of university patents, corporate purchase of prototypes developed by the university, joint publications, Use of intellectual property, co-founding technology-driven start-ups and more (Rossoni et al., 2023). Based on Jones & Corral de Zubielqui's (2017) classification method, this study divides university-industry collaboration into the following

six categories: Human resource transfer, Scientific publications, Intellectual property, informal sources of ideas, Research services and Research partnership. Diverse collaboration models yield varying values and advantages for enterprises. Subsequently, it will elucidate the influence of various integration modalities of industry and education on the financial performance of firms.

Human resource transfer (HRT), a crucial aspect of university-industry partnership, significantly enhances company financial performance by strengthening workforce skills, decreasing recruitment expenses, and promoting innovation. This partnership encompasses graduate recruiting, vocational training, and internships, equipping companies with proficient personnel capable of advancing technical innovation and enhancing product quality (Ankrah et al., 2013; Perkmann et al., 2021). Research demonstrates that organisations employing interns or graduates from university programs can substantially decrease adaptation time, with some reports indicating reductions of up to 50%, resulting in diminished labour risks and economic losses (Yessimova et al., 2024). The productive partnership between universities and industry typically facilitates the swift advancement of innovative goods and the improvement of operational efficiencies. Collaborative activities frequently yield creative solutions that satisfy market expectations, therefore promoting financial growth. In industries like transportation and biopharmaceuticals, utilising competent human resources has demonstrated significant enhancements in innovative results and financial performance. Companies that invest in graduates acquainted with their operational contexts have enhanced productivity and performance metrics, fostering a mutually beneficial partnership (Bacon & Williams, 2021; Xia, 2023). Notwithstanding these evident benefits, disparities between educational curriculum and industry requirements may impede the efficacy of collaborations. Educational programs frequently fail to sufficiently align with the swiftly changing demands of the work market, hence limiting the economic potential of HRT endeavours. It is essential for educational institutions and companies to maintain ongoing engagement to ensure that curricula stay pertinent and beneficial to future employers (Tekleselassie & Ford, 2019; White et al., 2020; Bock et al., 2021). The challenge is to create a sustainable and mutually advantageous partnership in which training institutions effectively equip students for workforce demands, while simultaneously granting industries access to new talent poised to innovate and advance their enterprises (Kenny et al., 2023). The above arguments have led to the development of the following hypothesis:
Hypothesis (H1): There is a positive relationship between human resource transfer and corporate financial performance

Scientific publications (SP) are a crucial element of university-industry collaboration, functioning as a fundamental conduit for information transfer and the advancement of innovation. Research indicates that scientific publications frequently exceed patents and licenses in their efficacy for sharing public research. These publications allow companies to access cutting-edge academic research, enhancing productivity and promoting technological innovation (Giones, 2019). The correlation between UIC and the effectiveness of scientific publications is widely acknowledged in both academia and industry, serving as a fundamental element in fostering innovation and economic development (Fernandes et al., 2020). Nonetheless, these collaborations may improve business financial performance, possible disadvantages remain, especially with collaborative management. Research has identified obstacles include publication delays, confidentiality issues, and limited information

dissemination, which are significant impediments to maximising the advantages of academic collaborations. Bikard et al. highlight the dangers of protracted publication processes, indicating that these obstacles may impede the transmission of essential information to commercial parties and hinder wider collaboration advantages (Uddin, 2021). Based on the discussions above, the following hypothesis is formalized:
Hypothesis (H2): There is a positive relationship between scientific publications and corporate financial performance

Intellectual property (IP) serves as a crucial conduit for the dissemination of university-generated discoveries, including patents, licenses, and designs, to businesses, hence conferring competitive benefits to firms (Jones & Corral de Zubielqui, 2017). Licensing is a prevalent approach by which universities convey tangible intellectual property to companies through formal agreements, enabling these companies to produce commercially viable inventions. Studies indicate that companies with robust university intellectual property connections frequently outperform in patent generation and product commercialisation (Singh & Kumar, 2022). University technology transfer offices are essential in the licensing procedure. Subsequent to faculty disclosures of prospective intellectual property, these offices are tasked with overseeing the patent application process, which may encompass the acquisition of copyrights when relevant. Nonetheless, obstacles persist. Certain scholars articulate apprehensions about bureaucratic inefficiencies in university technology transfer offices, which may impede prompt innovation (Semenya, 2020). The pursuit of financial benefits from intellectual property has prompted ethical concerns about research integrity, as professors may experience pressure to provide patentable outcomes that cater to commercial interests instead of genuine scientific exploration (Bogaard et al., 2023). Such influences may lead to what some refer to as a "conflict of interest," affecting the perceived integrity of academic research and its results. In accordance with the preceding debates, the subsequent hypothesis has been formulated:
Hypothesis (H3) There is a positive relationship between intellectual property and corporate financial performance

Informal sources of ideas (ISI) significantly contribute to university-industry collaboration, acting as adaptable yet influential conduits for information transfer (Jones & Corral de Zubielqui, 2017). The notion of informal academic relationships is gaining recognition, particularly in comparison to conventional collaborations. Informal settings frequently involve unstructured interactions that can significantly foster intellectual growth, even in the absence of formal agreements or documentation. Hughes emphasises that this informal interaction is essential for promoting innovation and problem-solving across diverse academic fields (Sá et al., 2019). These qualitative interactions replace formal agreements with personal relationships, indicating a transformative potential for innovation through relational dynamics (Sá et al., 2019). Research suggests that these informal contacts commonly transpire through casual means, such as face-to-face encounters, which improve communication and aid in overcoming orientation-related challenges typically found in formal collaborations. Bruneel et al. recognise informal gatherings as especially efficacious in surmounting organisational obstacles to collaboration, hence promoting a more rapid and natural interchange of ideas and knowledge (Gravili et al., 2020). Although informal academic connections may offer advantages, they are not without disadvantages. The informal character of these interactions creates opportunities for problems, especially around

intellectual property rights and the ownership of shared ideas. Hou et al. emphasise that the unrestricted interchange of insights may intensify conflicts about intellectual property (Deeken et al., 2020). In line with the above discussions, the following hypothesis has been developed:
Hypothesis (H4): There is a positive relationship between informal sources of ideas and corporate financial performance

Research services (RS) represent a crucial modality of university-industry collaboration, wherein universities extend specialised research assistance to enterprises via contract research, academic consulting, and the involvement of contracted academic personnel (Perkmann & Walsh, 2007; Jones & Corral de Zubielqui, 2017). These collaborations are organised through written agreements that delineate objectives and deliverables, guaranteeing explicit expectations and quantifiable outcomes (D'Este & Patel, 2007). Although such partnerships can improve collaboration quality and decrease transaction costs (Yoshioka-Kobayashi & Takahashi, 2022), issues like unstable job arrangements for contracted academic personnel may obstruct favourable results. Contract researchers frequently encounter precarious career trajectories, insufficient institutional backing, and constrained chances for professional promotion, which may adversely affect their engagement and productivity (Solomon, 2024; Willson et al., 2022). Notwithstanding these apprehensions, outsourcing research and development to universities continues to be a financially advantageous approach that minimises expenses and provides companies with access to specialised expertise and research infrastructure, hence enhancing innovation and financial outcomes (Costa et al., 2021). This leads to the formation of the following hypothesis:
Hypothesis (H5): There is a positive relationship between research services and corporate financial performance

Research partnerships (RP) signify formal accords between entities to cooperate on research and development initiatives, including collaborative projects, funded research, and the creation of university-industry research centres (Perkmann & Walsh, 2007; Jones & Corral de Zubielqui, 2017). In the medical domain, these collaborations—commonly referred to as industry-sponsored research—encompass financial backing, research guidance, and direct laboratory participation. Such structures are sometimes bolstered by public policy initiatives, with programs such as Science and Technology Centres (S&TCs) and Engineering Research Centres (ERCs) financed by the National Science Foundation serving crucial roles (Perkmann & Walsh, 2007). A prominent U.S. electronics case study illustrated that research joint ventures can markedly decrease R&D costs and expedite development timelines (Perkmann & Walsh, 2007). Companies gain advantages from these collaborations by lowering R&D expenses, sharing risks, pooling resources, and obtaining complementary skills that foster innovation (Caloghirou et al., 2021). Contract-supported research, wherein academic researchers execute projects under formal agreements, guarantees timely and budget-compliant research findings, thus optimising firms' profits (Abidin et al., 2016). Furthermore, delegating research and development to academic institutions enables corporations to methodically leverage external expertise, thereby realising economies of scale and breadth (Scandura, 2016). Nonetheless, challenges remain; Bacon and Williams (2021) underscore the intricacies involved in managing university-industry ecosystem partnerships, while potential risks, including intellectual property disputes, excessive industry influence on academic research, and constraints on intellectual freedom and publication rights, may jeopardise the

anticipated advantages (Mirza et al., 2020). This has led to the development of the following hypothesis:

Hypothesis (H6): There is a positive relationship between research partnerships and corporate financial performance

Methodology

Research Framework

This study examines the influence of several IEI strategies on corporate financial performance. Informed by the Resource-Based View (RBV) paradigm, the study identifies research needs by delineating IEI enterprises and selecting 166 publicly traded Chinese corporations as the sample. Data were obtained via a questionnaire survey and secondary financial information from the CSMAR database. Six IEI models—human resource transfer, scientific publications, intellectual property, informal idea sources, research services, and research partnerships—were analysed by simple linear regression to evaluate their individual effects on CFP, quantified by Net Profit, ROA, and ROE. The specific research framework is illustrated in Figure 1.

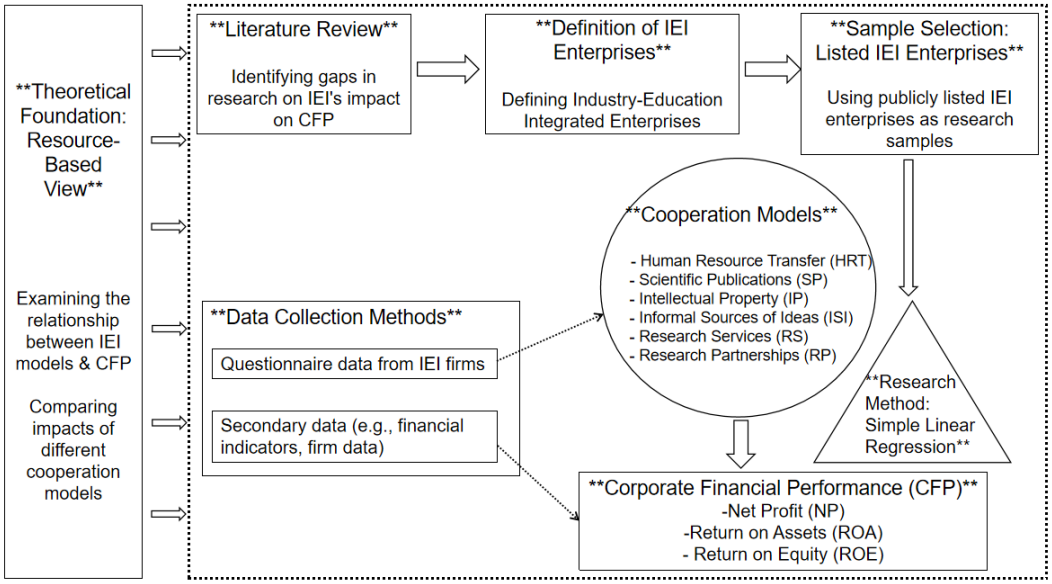

Figure 1. Research framework.

Sample Selection

This study employs Chinese publicly traded enterprises as a research sample for the following reasons. Firstly, publicly traded firms must adhere to stringent financial disclosure requirements, enabling them to furnish full, transparent, and standardised financial information. This can enhance the precision and reliability of the research findings. Publicly traded corporations are required to adhere to standardised accounting principles and reporting methodologies. This consistency facilitates rigorous empirical research, reduces potential measurement mistakes, and enhances the trustworthiness of statistical models. Secondly, publicly traded corporations typically serve as industry leaders with significant market impact, rendering them indicative of wider economic trends. Examining their financial performance can yield insights applicable to other organisations within a comparable economic and industrial context. Third, the Chinese government actively advocates for the integration of industry and education to foster technological innovation and economic

transformation, with listed companies frequently emerging as the primary beneficiaries due to their robust resource integration and innovation capabilities. Analysing these companies can furnish policymakers with substantial evidence on the efficacy of the IEI agenda. The objective of this study is to investigate whether various IEI models may enhance corporate financial performance; therefore, the research subjects must be companies that have engaged in IEI. This study ultimately selected listed IEI businesses as the research sample, in conjunction with the aforementioned improved conditions of publicly traded firms.

This study relies on the national list of IEI enterprises issued by the National Development and Reform Commission, as well as the provincial lists published on the official websites of the Development and Reform Commissions of provinces, autonomous regions, and municipalities directly under the central government. The entities in the list are classified as IEI firms. As of June 14, 2023, statistics indicate the existence of 63 national-level IEI firms, 5,247 provincial-level IEI enterprises, culminating in a total of 5,301 IEI enterprises across the nation. A list of IEI enterprises has been aligned with the roster of Chinese listed corporations, resulting in the identification of 349 listed IEI enterprises. ST corporations and financial firms are omitted, but companies with complete data for 2022 are maintained, resulting in a total of 178 IEI listed companies. This study examines publicly listed companies involved in IEI and employs a basic linear regression method to analyse the effect of various IEI models on corporate financial performance. The objective is to investigate if enterprise engagement in IEI enhances corporate financial performance, and to identify which integration model is most beneficial for such performance. To offer enhanced collaboration strategies for firms to engage in IEI and to more effectively support the advancement of industrial upgrading for businesses.

Empirical model

A simple linear regression model was fitted to examine the relationship between the six modes of IEI and corporate financial performance. The following equation represents simple linear regression model:

$$CFPi = ∂1 + ∂2 \text{ six modes of IEIi} + εi$$

where six modes of IEIi are the i measurement of independent variables, CFPi is the i measurement of the dependent variable, ∂1 and ∂2 are regression coefficients referred to as the intercept and slope, respectively, and εi is the error term associated with it (Gujarati & Porter, 2010).

Data Acquisition

This study utilises cross-sectional data from 2022, encompassing 166 Chinese publicly traded companies involved in IEI, and performs simple linear regression to examine the influence of various IEI models on company financial performance. The inventory of IEI enterprises is sourced from the official websites of the National Development and Reform Commission, the development and reform commissions of provinces, autonomous prefectures, and municipalities directly under the Central Government. The secondary data on CFP, which includes metrics such as Net Profit, Return on Assets (ROA), and Return on Equity (ROE), and control variables such as firm age, firm growth, asset-liability ratio, and operating cash flow, was obtained from the Guotai'an (CSMAR) database. Furthermore, six categories of IEI modalities, encompassing human resource transfer (HRT), scientific publication (SP), intellectual property (IP), informal sources of ideas (ISI), research services (RS), and research

partnerships (RP), were employed as principal explanatory variables. The data originated from a dichotomous questionnaire survey, offering respondents the choices of "yes" or "no". "Yes" indicates that the firm has engaged in a certain IEI model, while "no" signifies that the enterprise has not engaged in such a model. "Yes" is assigned a value of 1, whereas "no" is assigned a value of 0. A total of 178 questionnaires were disseminated to IEI firms by public email, accompanied with the QR code and web link for the Questionnaire Star, resulting in the collection of 166 valid responses.

The data was processed to mitigate the influence of outliers. Net profit was calculated by adding the absolute value of the minimum value, applying the logarithm, and subsequently truncating the tail. Control variables such as business growth rate, debt-to-asset ratio, operating cash flow, return on assets (ROA), and return on equity (ROE) were also shrinked the tail. The definitions of the employed indicators are presented in Table 1.

Table 1
The definitions and explanations of variables.

Types	variables	Symbols	Definitions
Explained Variables	Corporate financial performance	CFP	Net Profit, ROA, ROE
Explanatory variables	Human Resource Transfer	HRT	Dichotomous variables, the corporate has participated in HRT takes the value of 1, otherwise 0
	Scientific Publications	SP	Dichotomous variables, the corporate has participated in SP takes the value of 1, otherwise 0
	Intellectual Property	IP	Dichotomous variables, the corporate has participated in IP takes the value of 1, otherwise 0
	Informal Sources of Ideas	ISI	Dichotomous variables, the corporate has participated in ISI takes the value of 1, otherwise 0
	Research Services	RS	Dichotomous variables, the corporate has participated in RS takes the value of 1, otherwise 0
	Research Partnerships	RP	Dichotomous variables, the corporate has participated in RP takes the value of 1, otherwise 0
Control variables	Firm Age	Age	Company has been listed
	Firm Growth	Growth	Growth rate of main business income
	Asset-liability ratio	Lev	Ratio of total liabilities to total assets
	Operating cash flow	Ocf	Net Income+Non-cash Expenses+Changes in Working Capital

Empirical Results and Discussion

Descriptive Statistics

The questionnaire survey results indicate that, among the six IEI models, HRT exhibits the highest involvement percentage, with 132 out of 166 enterprises responding affirmatively (see Figure 1), resulting in a participation rate of 80.7%. The second highest is IP, with 126 out of 166 enterprises selecting "YES", resulting in a participation rate of 75.9%. Fifty percent of the companies engaged in the RP cooperation approach, while the remaining fifty percent did

not. The involvement rates of firms in the three cooperation models—SP, ISI, and RS—were rather low, at 39.2%, 32.5%, and 29.5%, respectively.

Figure 2. Involvement in six models of industy-education integration.

Descriptive statistics were employed to analyse the influence of various IEI models on company financial performance by summarising the dataset's essential characteristics. Table 2 displays the descriptive statistics for all variables utilised in the investigation. Net Profit, the principal measure of corporate financial success, with an average value of 24.272 and a standard deviation of 0.085, signifying minimal variation among organisations. The net profit range of 24.146 to 24.758 indicates a stable financial result throughout the sample. The performance indicators, ROA and ROE, demonstrate mean values of 0.031 and 0.046, respectively. Although both metrics exhibit modest averages, the comparatively higher standard deviation of ROE (0.132) in contrast to ROA (0.052) indicates increased unpredictability in enterprises' equity returns.

Regarding the variables of IEI, HRT, SP, IP, ISI, RS, and RP are binary variables (0 or 1), indicating the existence or absence of particular IEI models. The mean values fluctuate between 0.295 and 0.807, signifying differing levels of adoption. Significantly, HRT exhibits the highest mean value (0.807), indicating it is the most prevalently utilised IEI model, whilst RS demonstrates the lowest mean (0.295). Control variables have significant distribution characteristics. The average age of the enterprises is 24.259 years, with a range of 15 to 42 years, signifying a mature sample. Lev possesses a mean of 0.474 and a standard deviation of 0.171, indicating moderate levels of financial leverage. The mean growth is 0.056, although the extensive range (-0.614 to 0.962) indicates significant variability in growth rates. Finally, Ocf exhibits a mean of 0.054, a minimum of -0.144, and a high of 0.28, demonstrating varied cash flow performance among enterprises. The descriptive statistics reveal significant variability in business characteristics and the adoption of the IEI model, emphasising the necessity for additional investigation to explore the links between these variables and corporate financial success.

Table 2
Descriptive statistics

Variables	Obs	Mean	Std.Dev.	Min	Max
Net Profit	166	24.272	.085	24.146	24.758
ROA	166	.031	.052	-.127	.145
ROE	166	.046	.132	-.559	.262
HRT	166	.807	.396	0	1
SP	166	.392	.49	0	1
IP	166	.759	.429	0	1
ISI	166	.325	.469	0	1
RS	166	.295	.458	0	1
RP	166	.5	.502	0	1
Age	166	24.259	4.932	15	42
Lev	166	.474	.171	.123	.821
Growth	166	.056	.247	-.614	.962
Ocf	166	.054	.065	-.144	.28

Simple Linear Regression Results

Table 3 displays the outcomes of the basic linear regression models analysing the influence of different IEI models on company financial performance, quantified by Net Profit. The results demonstrate that various IEI models substantially improve organisational performance.

HRT demonstrates a positive and significant coefficient of 0.0511 ($p < 0.01$), indicating that companies involved in human resource transfer operations with universities are likely to attain greater net profits. This outcome corresponds with prior research indicating that talent exchange enhances knowledge transfer, augments innovation capacities, and increases operational efficiency. SP exhibit a substantial positive impact with a coefficient of 0.0383 ($p < 0.01$), signifying that enterprises utilising scientific publications as a knowledge resource gain advanced research insights that can inform innovation processes and strategic decisions. IP demonstrates a notable positive effect, with a coefficient of 0.0396 ($p < 0.05$), indicating that companies engaged in IP collaborations achieve financial benefits through superior innovation results and increased management of intellectual assets. The coefficient for ISI is 0.0507 ($p < 0.01$), signifying that informal information exchanges—such as networking, conferences, and informal contacts with academic experts—substantially improve corporate financial performance. This highlights the importance of informal pathways in promoting agile and swift knowledge acquisition. RS attains the greatest significance and effect size, with a coefficient of 0.0529 ($p < 0.01$). This outcome indicates that companies leveraging universities' specialised research services gain cost-efficient research assistance and enhanced technical progress, directly leading to improved financial results. In contrast, RP demonstrates a little effect (coefficient = 0.0117, $p > 0.1$), suggesting that formalised, long-term research relationships may not produce prompt financial benefits. This may indicate the extended timelines and intricate coordination necessary in such partnerships, potentially postponing financial benefits.

The R-squared values span from 0.2201 to 0.2910, indicating that the models account for a moderate share of the variance in net profit. The model that includes research services attains the greatest R-squared value (0.2910), signifying that research services have the most substantial explanatory influence on corporate financial performance. These results indicate

that various IEI models differ in their influence on business profitability. Companies seem to derive the greatest advantage from knowledge sources that are easily accessible and immediately relevant to innovation and operational efficiency, including research services, informal knowledge exchanges, and human resource transfers. Concurrently, research partnerships may necessitate long-term plans to produce concrete financial advantages.

Table 3
Results of simple linear regression (Net Profit).

Variables	(1) HRT	(2) SP	(3) IP	(4) ISI	(5) RS	(6) RP
	.0511***	.0383***	.0396**	.0507***	.0529***	.0117
	(3.00)	(3.10)	(2.54)	(3.57)	(4.12)	(0.94)
Age	.0012	.0010	.0013	.0017	.0008	.0014
	(1.02)	(0.08)	(1.10)	(1.39)	(0.65)	(1.10)
Lev	.0841**	.0431	.0765**	.0461	.0292	.0475
	(2.29)	(1.23)	(2.08)	(1.34)	(0.85)	(1.33)
Growth	.0764***	.0912***	.0813***	.0765***	.0914***	.1001***
	(2.86)	(3.61)	(3.03)	(2.95)	(3.73)	(3.82)
Ocf	.3134***	.3078***	.3195***	.2309**	.3271***	.3399***
	(3.23)	(3.17)	(3.27)	(2.29)	(3.47)	(3.44)
Number of obs	166	166	166	166	166	166
R-squared	0.2577	0.2602	0.2461	0.2736	0.2910	0.2201

Note: 1) t-value in parentheses; 2) *, **, and *** indicate the significance levels of 10 %, 5 %, and 1 %, respectively.

Robustness Test Results: Alternative Metrics for Financial Performance
This study utilises ROA and ROE as alternative dependent variables to assess company financial performance, thereby scrutinising the robustness of the prior findings. The regression findings displayed in Table 4 and Table 5 offer novel insights into the correlation between different IEI models and business performance.

Outcomes for ROA
The regression outcomes for ROA (Table 4) indicate significant disparities in comparison to the Net Profit model. HRT exhibits a robust positive impact, with a coefficient of 0.0746 ($p < 0.01$), underscoring the significance of talent exchange in improving financial results. Simultaneously, SP exhibits a positive and statistically significant correlation (coefficient = 0.0216, $p < 0.01$), however with a diminished effect size compared to the Net Profit model.

Both IP and ISI are statistically significant at the 1% level, with coefficients of 0.0557 and 0.0548, respectively, suggesting that enterprises utilising these knowledge channels consistently achieve enhanced asset efficiency. Significantly, RS exhibits a diminished effect on ROA (coefficient = 0.0168, $p < 0.05$) in contrast to its comparatively greater impact on Net Profit. In contrast, RP attains statistical significance (coefficient = 0.0273, $p < 0.01$), differing from its prior insignificant impact on Net Profit. This indicates that research collaborations, albeit not producing immediate financial returns, may enhance resource allocation and operational efficacy.

Table 4
Results of simple linear regression (ROA).

Variables	(1) HRT	(2) SP	(3) IP	(4) ISI	(5) RS	(6) RP
	.0746***	.0216***	.0557***	.0548***	.0168**	.0273***
	(11.64)	(3.54)	(8.41)	(9.20)	(2.54)	(4.69)
Age	-.0003	-.0040	-.0002	.0002	-.0003	-.0001
	(-0.69)	(-0.59)	(-0.31)	(0.41)	(-0.53)	(-0.19)
Lev	-.0556***	-.1098***	-.0682***	-.1098***	-.1127***	-.1106***
	(-4.01)	(-6.36)	(-4.38)	(-7.58)	(-6.35)	(6.58)
Growth	.0340***	.0690***	.0427***	.0454***	.0727***	.0635***
	(3.38)	(5.53)	(3.75)	(4.18)	(5.77)	(5.17)
Ocf	.2232***	.2497***	.2337***	.1466***	.2654***	.2563***
	(6.10)	(5.21)	(5.65)	(3.48)	(5.48)	(5.52)
Number of obs	166	166	166	166	166	166
R-squared	0.7181	0.5174	0.6390	0.9596	0.4998	0.5425

Note: 1) t-value in parentheses; 2) *, **, and *** indicate the significance levels of 10 %, 5 %, and 1 %, respectively.

Outcomes for ROE

In Table 5, with ROE as the dependent variable, all six IEI models have statistically significant positive effects. HRT has the most substantial effect with a coefficient of 0.1919($p < 0.01$), highlighting the considerable financial gains that companies may realise by recruiting and assimilating academic talent. IP and ISI demonstrate significant beneficial impacts with coefficients of 0.1386 and 0.1059 (both $p < 0.01$), underscoring the value of utilising intellectual property and informal knowledge networks. The values for SP (0.0595, $p < 0.01$) and RS (0.0507, $p < 0.01$) signify ongoing beneficial contributions, though to a diminished degree. RP is significant in our model (coefficient = 0.0681, $p < 0.01$), indicating that although research partnerships may necessitate extended investment horizons, they ultimately yield positive contributions to equity returns.

Table 5
Results of simple linear regression (ROE)

Variables	(1) HRT	(2) SP	(3) IP	(4) ISI	(5) RS	(6) RP
	.1919***	.0595***	.1386***	.1059***	.0507***	.0681***
	(11.06)	(3.69)	(7.72)	(6.03)	(2.92)	(4.40)
Age	.0001	-.00003	.0005	.0012	-5.95e-06	.0006
	(0.08)	(-0.02)	(0.36)	(0.82)	(-0.00)	(0.40)
Lev	-.0865**	-.2265***	-.1222***	-.2236***	.2361***	-.2277***
	(-2.30)	(-4.97)	(-2.89)	(-5.23)	(5.06)	(5.08)
Growth	.1175***	.2059***	.1426***	.1276***	.2149***	.1944***
	(4.31)	(6.26)	(4.63)	(5.21)	(6.49)	(5.94)
Ocf	.4424***	.5065***	.4725***	.3250***	.5480***	.5285***
	(4.47)	(4.01)	(4.21)	(2.61)	(4.30)	(4.27)
Number of obs	166	166	166	166	166	166
R-squared	0.6764	0.4737	0.5837	0.5345	0.4578	0.4904

Note: 1) t-value in parentheses; 2) *, **, and *** indicate the significance levels of 10 %, 5 %, and 1 %, respectively.

Principal Distinctions and Consequences

The findings for the ROA and ROE models indicate notable distinctions when contrasted with the Net Profit model: RP demonstrates more importance in the ROA and ROE models, suggesting that these collaborations may exert a delayed yet substantial influence on financial stability and growth. RS exhibits a diminished effect in the ROA model while retaining importance for ROE, indicating its relevance may be more pronounced in relation to equity returns than to immediate profitability. The comparatively elevated R-squared values for the ROA model, especially for HRT (0.7181) and ISI (0.9596), signify enhanced explanatory capacity for these variables in elucidating asset efficiency.

These robustness tests demonstrate that IEI models consistently enhance company financial performance, with differences in impact magnitude contingent upon the financial metric employed. The pronounced impact of research partnerships and services on ROA and ROE indicates that enterprises employing these strategies may achieve enduring advantages in resource management and long-term shareholder value.

Conclusions, Implications and Limitations

This study examines the influence of diverse IEI models on corporate financial performance utilising data from 166 publicly traded businesses in China. The empirical findings demonstrate clear trends concerning the efficacy of various IEI modes in improving financial results.

The results demonstrate that all six IEI models show positive correlations with business financial success, while the significance and explanatory strength differ among them. Among them, HRT exhibits the most significant and persistent positive impact on all three financial metrics. This indicates that the direct transfer of personnel between academics and industry significantly improves enterprises' operational efficiency and innovative potential, resulting in enhanced financial performance. SP and ISI demonstrate substantial positive effects, especially on profitability metrics like ROA and ROE. This highlights the importance of knowledge diffusion and informal idea exchanges in enhancing organisations' financial performance, particularly in innovation-driven industries. Moreover, IP holds substantial importance, indicating that cooperative initiatives to safeguard and monetise intellectual assets significantly enhance financial results. RS and RP exhibit comparatively lesser yet favourable benefits, with their significance differing across financial metrics, indicating that their impact may be contingent upon contextual variables or modified by supplementary firm-level factors.

Notwithstanding the substantial findings, this study possesses specific limitations. The data collection is cross-sectional, restricting the capacity to observe dynamic and developing interactions across time. Future study could benefit from employing a longitudinal methodology to investigate the enduring effects of IEI models on business performance. The binary form of the explanatory variables (yes/no) reduces the complexity of collaboration intensity and depth, perhaps obscuring significant nuances. Integrating a more detailed assessment of IEI involvement levels may provide deeper insights. Ultimately, the study's dependence on data from publicly traded companies may restrict the generalisability to smaller or privately owned enterprises that may implement different IEI methods.

Future research could investigate the mediating function of innovation performance in the relationship between innovation ecosystem integration and corporate financial performance to elucidate the mechanisms influencing financial results. Moreover, sector-specific analyses may reveal distinct patterns across industries, providing useful information for policymakers and managers. Subsequent study should investigate cultural and institutional elements that may influence the effectiveness of various IEI models across different economic circumstances.

These findings have numerous policy ramifications. Policymakers ought to prioritise programs that enable the transfer of human resources and the exchange of talent between academics and industry, as this integration consistently yields beneficial effects on financial performance. Moreover, incentives to foster collaborative research services may motivate enterprises to enhance their participation in joint innovation initiatives. Managers are urged to employ a strategic methodology in selecting IEI models, ensuring alignment with their organization's financial goals and industry traits.

This study provides solid evidence that various IEI models have distinct impacts on business financial performance. By acknowledging the unique contributions of each model, companies may more effectively customise their collaborative strategies to attain improved profitability and sustainable growth.

Funding: This research is supported by the project “Exploration of Digital Reform in Marketing Practice Teaching Based on Industry Education Integration-Taking "Entrepreneurial Marketing Practice" as an Example” (Grant No.: 2025JY0058)

Data Accessibility Assertion: The dataset can be obtained upon request from the authors. The authors will provide the raw data supporting the conclusions of this article upon request.
Conflicts of Interest: The authors assert the absence of any conflicts of interest.

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